Vol. XVIII No. 4

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ANN ARBOR, MICHIGAN: 1958

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AGRICULTURE, GENERAL

HERBICIDE STUDIES: I. HERBICIDES AND ADJUVANTS ON CANADA THISTLE (CIRSIUM ARVENSE TOURN.) II. THE RELATION OF 2,4-DICHLOROPHENOXYACETIC ACID TO CERTAIN SOILS AND SOIL-LIKE MATERIALS

(L. C. Card No. Mic 58-700)

Gideon Dee Hill, Jr., Ph.D.
The Ohio State University, 1953

I. HERBICIDES AND ADJUVANTS ON CANADA THISTLE (Cirsium arvense Tourn.)

Canada thistle, a persistent perennial with creeping roots, causes severe losses wherever it becomes established. Since 1945, extensive studies on the use of 2,4-D and related compounds for the control of thistle have been conducted in the northern United States and southern Canada. The results have been extremely variable.

The experiments reported here are field studies to evaluate different rates and formulations of herbicides, with and without adjuvants, at several stages of growth, on the control of Canada thistle.

Post-emergence Applications of Herbicides and Adjuvants

A uniform stand of Canada thistle, with quack grass as a competitor, was treated 4 times—in May, 1951, and May, 1952, when thistles were 10" to 14", pre-bud to bud stage, and August, 1951, and August, 1952, when regrowth after mowing reached 5" to 6"—with the amine salt, isopropyl ester, polypropylene glycol butyl ether ester, and wettable acid of 2,4-D, polypropylene ester of 2,4,5-T, and amine salt of MCP at rates ranging from 1/16 to 20 lb. per acre. Sodium trichloroacetate (TCA) at 50, 100, and 200 lb. per acre and sodium chlorate at 500 lb. per acre were applied in May, 1951, only. Tween 20, sucrose, vitamin K, and oil carriers were used as adjuvants. Ratings were made in terms of per cent reduction of stand based on the nearest check plot.

Adjacent plots were treated with the salts and esters of 2,4-D, 2,4,5-T, and MCP at rates ranging from 1/8 to 16 lb. per acre in June, 1951, when thistles were 42" to 48" high with a few blooms visible, and in September, 1951, when the regrowth after mowing had reached a height of 4" to 6". Each stage of growth was a separate experiment. Stand counts and injury ratings were taken.

No single application of the growth regulators gave complete control of thistle, regardless of rate or formulation. Post-emergence applications of growth regulators gave the most effective stand reduction when applied at the pre-bud to bud stage. The application at the pre-bud stage of 1/16 or 1/8 lb. per acre repeated 2 or 4 days apart until 1/2 lb. per acre of 2,4-D or MCP was applied gave greater stand reductions after one year (2 applications) than the heavy rates, 1 1/2, 5, 10, and 20 lbs. per acre; but these differences disappeared by the end of the second year (4 applications). One-half pound of the amine salt of 2,4-D for four times also gave control equal to the heavy rates during the two year period. The heavy rates apparently killed the tops so quickly that little translocation of growth regulators occurred. Translocation of 2,4-D to the roots at the pre-bud stage, as determined by depth of root kill, was definitely greater where repeated small doses were applied 2 to 4 days apart than where the same amount was applied at one application.

None of the adjuvants gave increased control of thistle. 2,4-D was as effective as MCP at all rates. 2,4,5-T was definitely inferior to 2,4-D. Sodium TCA at 200 lb. per acre caused no visible injury to Canada thistle. Sodium chlorate at 500 lb. per acre suppressed thistle for 12 months, but with no retreatments the thistles recovered.

Pre-emergence Applications of 2,4-D and 2,4,5-T

In the course of studies of early post-emergence applications of the polypropylene ester of 2,4,5-T on corn in 1951 Canada thistle was completely controlled by 4 lb. per acre of 2,4,5-T pre-emergence. Following up this lead in 1952, pre-emergence applications of the amine salt of 2,4-D and polypropylene esters of 2,4-D and 2,4,5-T were applied to undisturbed sod in March, 1952, and to prepared soil in June, 1952, at rates varying from 2 to 32 lb. per acre.

Pre-emergence applications in March to dormant thistle in undisturbed sod were relatively ineffective. Five months after application, shoots had recovered and were capable of reinfesting the area unless spraying was continued.

Apparently because of dry weather in June, 1952, 16 lb. of 2,4-D or 32 lb. of 2,4,5-T per acre were required to give control equivalent to that obtained from 4 lb. per acre of 2,4,5-T in 1951.

Post-emergence Applications of Maleic Hydrazide

Post-emergence applications of 7 1/2 to 20 lb. per acre, active ingredient, of maleic hydrazide were made in May, 1952, to Canada thistle, 10" to 12" high, and quack grass, 6" to 8" high, followed by plowing after 8 days. These treatments gave no marked control of thistle. Quack grass was controlled by the 10 and 20 lb. per acre rates until October, 1952.

CONCLUSIONS

1) No single application of the growth regulators gave complete control of Canada thistle, regardless of rate or formulation.

2) Post-emergence applications of growth regulators gave the most effective stand reduction of thistle at the pre-bud to bud stage.

3) Translocation of 2,4-D to the roots at the pre-bud to bud stage was definitely greater where repeated small doses were applied 2 to 4 days apart than where the same amount was applied once. Slower top kill was related to increased translocation.

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4) One-half pound per acre of the amine salt of 2,4-D at one application gave control equal to the 5, 10, or 20 lb. per acre rate.

5) None of the adjuvants tried gave increased control of thistle.

6) The amine salt of 2,4-D was as effective as the amine salt of MCP at all rates.

7) 2,4,5-T was definitely inferior to similar rates of 2,4-D when applied post-emergence.

8) Preliminary studies suggested the possibility of controlling Canada thistle by pre-emergence applications.

II. THE RELATION OF 2,4-DICHLOROPHENOXYACETIC ACID TO CERTAIN SOILS AND SOIL-LIKE MATERIALS

Pre-emergence weed control promises to become a widely adopted practice. Basic information is needed on the behavior of 2,4-D and related compounds in the soil before this method can be safely and surely used to control weeds in corn and other crops.

Fixation of 2,4-D on Soils and Soil-like Materials

Several reports[1,2,3,4] have indicated that 2,4-D may be fixed on soil colloids. The fixation of 2,4-D on several soil-like materials and on three important Ohio soils, varying widely in clay content, organic matter content, and exchange capacity, was studied in the laboratory.

Standard curves were obtained for the growth of cucumber seedlings in solutions of the amine salt and emulsions of the isopropyl and polypropylene ester of 2,4-D at concentrations ranging from 0.01 to 5.0 p.p.m. acid equivalent.

Varying amounts of soil or soil-like materials (Table I) were weighed into paired 250 ml. centrifuge tubes. Known amounts of 2,4-D, usually 100 ml. of approximately a 10 p.p.m. solution or emulsion, were added to the tubes. The tubes were stoppered, shaken intermittently over a 2-hour period, centrifuged, and the supernatant liquid decanted. The residue in the tubes was then washed three times with 75 ml. distilled water by stirring on a Multimixer milk shake machine for 90 seconds followed by centrifuging. The decanted supernatant liquid from all operations was combined, and the cucumber bioassay of Ready and Grant[5] was used to determine the amount of 2,4-D removed.

The effect of the soils and soil-like materials on the fixation of 2,4-D is shown in Table I. A material x formulation interaction is indicated. Silica sand fixed no appreciable amounts of 2,4-D. The bentonite, illite, and kaolinite clays, listed in decreasing order of specific surface area, each fixed more ester than amine. There is a definite relation between the amount of fixation and the exchange capacity and surface area of the clays.

The isopropyl and polypropylene esters were retained to the same extent by calcium bentonite.

The total amount of 2,4-D (amine and ester) fixed by the Rifle peat, Brookston silty clay loam, and Miami silt loam was associated with their cation exchange capacity and surface area, but each soil fixed amine and ester to approximately the same extent. Upon removal of the organic matter by the use of hydrogen peroxide both the Brookston and Miami soils inactivated larger amounts of amine and ester, and each soil type showed a differential adsorption of ester over amine. There is no clear explanation for this.

When concentrations of 13 p.p.m. and 130 p.p.m. of

Table I. Effect of Certain Soils and Soil-like Materials on the Fixation of 2,4-D.

Material*	Grams used	γ 2,4-D, acid equivalent, fixed per gram soil or soil material			
		Amine salt	Polypropylene ester	Isopropyl ester	Average
Rifle peat	15	46.0	47.0		46.5
Brookston silty clay loam	30	16.2	13.8		15.0
Miami silt loam	30	8.6	9.6		9.1
Calcium bentonite	25	17.2	30.8	31.1	26.3
Illite	35	8.1	23.9		16.0
Kaolinite	35	9.4	16.6		13.0
Iron oxide powder	30	0.3	14.2		7.3
Silica sand	50	0.1	0.1	0.2	0.1
Average		13.2	19.5	15.7	
		.05 / .01			
L.S.D. Material		5.2 / 26.1			
L.S.D. Formulation		3.3	7.0		
L.S.D. Material x formulation		6.5	14.0		

*Silica sand (25 grams) was mixed with each soil or soil material. The data refer to amount of fixation by a material and not to fixation by a mixture of sand and a material.

2,4-D were added to samples of calcium bentonite, the amount of ester adsorbed was approximately in direct proportion to the amount added, whereas the amount of amine adsorbed was about the same at each concentration.

The addition of an aromatic petroleum derivative to the polypropylene ester gave an increase in retention over the ester without additional oil by calcium bentonite.

Movement, Fixation, and Relative Availability of 2,4-D in Miami and Brookston Soils and in Washed Silica Sand

Aldrich[6] reported that the amine salt of 2,4-D moved through a loam soil of the Nixon catena much more readily than the butyl ester under the influence of percolating water. The preceding experiments in this study indicated that both Miami and Brookston soils, with organic matter intact, fixed amine and ester to the same extent. Leaching studies were designed to check these apparent inconsistencies.

Series of soil percolation tubes were packed separately with 250 grams of Miami soil, 3-inch depth; 250 grams of Brookston soil, 4-inch depth; and 300 grams of washed silica sand, 3-inch depth. The amine salt and polypropylene ester of 2,4-D were applied at the rate of 13 lb. per acre by allowing the solutions to drop slowly on the soil surface. Each of the two soils was leached with the equivalent of 6 surface inches of distilled water and the sand with 3 surface inches. The concentration of 2,4-D in the leachate was measured by the cucumber bioassay method. The soils were extruded, cut into 1-inch segments, and the depth of penetration of 2,4-D determined both by washing the soil and testing the "washing" for 2,4-D and by

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growing cucumber and corn seedlings in the 1-inch segments.

The per cent of 2,4-D fixed of the original amount added to Miami and Brookston soils is shown in Table II. A soil x formulation interaction is suggested. The ester was retained to a greater extent than the amine by both soils.

The growth of corn roots in Brookston soil and cucumber shoots in Miami soil after the soils were leached with the equivalent of 6 surface inches of water is shown in Table III. A large portion of the amine salt either moved through the soil or remained in the bottom inch, whereas the ester form remained concentrated in the top inch of both soils, although a measurable amount was present throughout the columns.

The entire amount of amine salt applied to silica sand was recovered in the leachate, while 52 per cent of the original amount of ester was retained. The adsorbed ester killed germinating cucumber seedlings, hence was readily available to them.

Table II. Effect of Leaching With the Equivalent of 6 Surface Inches of Distilled Water on the Retention of 2,4-D, Applied at the Rate of 13 Pounds Per Acre, Acid Equivalent, by 250 Gram Samples of Miami Silt Loam and Brookston Silty Clay Loam.

Soil	2,4-D, acid equivalent, amount fixed of original amount added		
	Amine salt	Polypropylene ester	Av. each soil type
	Pct.	Pct.	Pct.
Miami silt loam	18.5	65.2	41.9
Brookston silty clay loam	54.4	81.1	67.8
Average	36.5	73.2	

Table III. Growth of Corn Roots (mm.) in Brookston Silty Clay Loam and Cucumber Shoots (mm.) in Miami Silt Loam Previously Treated With 2,4-D, 13 Pounds Per Acre, Acid Equivalent, and Leached With the Equivalent of 6 Surface Inches of Distilled Water.

2,4-D formulation	Brookston soil	Miami soil
	Length of corn roots	Length of cucumber shoots
	mm.	mm.
Amine salt		
first inch	26	37
second inch	43	40
third inch	38	28
fourth inch	12	-
Average	30	35
Polypropylene ester		
first inch	6	0
second inch	25	5
third inch	29	15
fourth inch	27	-
Average	22	7
Check (average of all depths)	88	36

CONCLUSIONS

1) Fixation of both amine salt and polypropylene ester formulations of 2,4-D by montmorillonite, illite, and kaolinite clays was indicated. More 2,4-D as ester than as amine was retained by each clay.

2) The isopropyl and polypropylene esters of 2,4-D were retained to the same extent by calcium bentonite.

3) Silica sand fixed no appreciable amounts of 2,4-D against the forces of vigorous washing.

4) The polypropylene ester did not move as freely as the amine salt with percolating water in Miami silt loam and Brookston silty clay loam soils or in silica sand. An interaction between soil type and 2,4-D formulation was indicated.

5) The growth of cucumber and corn seedlings in leached 2,4-D treated soils indicated that much, perhaps all, of the ester which was held against the forces of percolating water was readily available or active.

6) The differential adsorption by the soil materials of esters of 2,4-D over the amine salt appeared to be related to the oil and/or the emulsion stabilizer contained in the commercial ester formulation. 169 pages. $2.25.

1. Aldrich, R. J. "Factors Affecting the Practicability of the Pre-emergence Use of 2,4-D in Corn." Doctoral dissertation, The Ohio State University, 1950.

2. Crafts, A. S. "Toxicity of 2,4-D in California Soils," Hilgardia, 19 (1949), pp. 141-158.

3. Audus, L. J. "The Biological Detoxification of Hormone Herbicides in Soil," Plant and Soil, 3 (1951), pp. 170-191.

4. Weaver, R. J. "Reaction of Certain Plant Growth Regulators With Ion Exchangers," Bot. Gaz., 109 (1947), pp. 72-84.

5. Ready, D., and Grant, V. Q. "A Sensitive Method for Determination in Low Concentrations of 2,4-Dichlorophenoxyacetic Acid in Aqueous Solution," Bot. Gaz., 109 (1947), pp. 39-44.

6. Aldrich, R. J., loc. cit.

Abstract published by special arrangement with The Ohio State University.

A METHOD FOR THE QUANTITATIVE DETERMINATION OF CLAY MINERAL MIXTURES BY X-RAY DIFFRACTION AND ITS APPLICATION TO FOUR SOILS OF SOUTHEAST KANSAS

(L. C. Card No. Mic 58-1262)

Neldon Lynn Jarvis, Ph.D.
Kansas State College, 1958

The objectives of this investigation were: (1) to develop a procedure for quantitative analysis of clay minerals using photographic X-ray diffraction procedures, (2) to determine the accuracy of such a procedure using synthetic mixtures of commercially obtained samples of various clay minerals, (3) to identify and semi-quantitatively analyze the clay minerals appearing in the profiles and parent materials of four southeast Kansas soils, (4) to relate the clay mineral content of the soil fractions to various physical and chemical properties of the fractions,

and (5) to ascertain the role the parent materials played in the development of the clay minerals.

The quantitative determination of clay minerals by X-ray diffraction procedures was investigated using MgO as an internal standard. The determination of intensity constants for the 001 diffraction lines of illitic, kaolinitic and montmorillonitic types of clay was made with reference to the 1.48 Å MgO diffraction line. These constants were calculated using the integrated intensity of the specified diffraction lines, the known weights of clay and MgO in each sample and the calculated value for the intensity of the MgO line. For kaolinitic and illitic types of clay the constants were evaluated with less than 2 per cent average deviation, whereas for the montmorillonitic types the average deviations varied from 2 to 5 per cent, depending upon the sample used.

From the intensity constants from the 001 diffraction lines of each clay species present in a mixture and the integrated intensity of the respective lines, the percentage composition of known synthetic mixtures of two and three components was determined with an average deviation of 1.87 per cent from the actual composition. It was found that clay constituents appearing in quantities less than 10 per cent by weight gave considerably larger deviations, and in the case of such small quantities of illitic types the diffraction line often could not be differentiated from the background radiation.

The soils studied were the Planosol, Prairie and Reddish Prairie soils of southeast Kansas which developed in place from residual deposits of clay shale, limestone, sandstone, siltstone and silty shale. Information was obtained to determine the extent to which the inherent differences in the parent materials are reflected in certain physical and chemical properties of the developed soil series, with emphasis placed on the clay minerals. Four soil series, Newtonia, Taloka, Summit and Bates, each developed upon a different type of parent material, were sampled in duplicate. The various properties studied, in addition to the clay minerals, were exchange capacity, total exchangeable cations, pH, per cent organic matter and particle size distribution.

The qualitative and semi-quantitative estimations made of the clay minerals of the developed profiles and underlying parent material were carried out using the procedure outlined above. The predominant clay mineral in the Taloka, Newtonia and Bates soil series was montmorillonite, while interstratified illite and montmorillonite was predominant in the Summit series. Varying amounts of illite, kaolinite, vermiculite and quartz were also detected in the soil profiles.

The clays present in the Taloka and Newtonia soils appeared to have been inherited directly from their parent materials. The clays in the Bates and Summit soils showed the effects of moderate weathering, as the clays appearing in the developed soil profiles were somewhat altered from the clays present in the parent materials. The clays present in the soil profiles studied are less dependent upon weathering and more dependent upon the clay mineral species inherited from the parent materials than was previously assumed. 92 pages. $2.00.

A COMPARISON OF F_3 LINES AND THEIR RELATED F_6 LINES IN TWO BARLEY CROSSES

(L. C. Card No. Mic 58-1130)

Ronald Ian Hector McKenzie, Ph.D.
University of Minnesota, 1957

Adviser: J. W. Lambert

In the improvement of a crop by means of hybridization, a plant breeder must try to bring together in one plant a number of agronomic and "quality" characteristics. Some of these are simply inherited while others are inherited in a complex manner. It would be a great help to a barley breeder if he could select in early segregating generations, those plants or lines which contain the most desirable combination of genes. Intensive selection work could then be carried out within these lines while other lines with less favorable combinations of genes could be discarded.

The main objectives of this study were (1) to evaluate testing for yield and other quantitative characters in the F_3 generation and (2) to evaluate the effectiveness of divergent visual selection for yield potential and other desirable characters in the F_4 and F_5 generations. In addition associations between various characters were studied as was also a non-replicated procedure for evaluating lines.

Sixty-eight pairs of selections from the barley cross Feebar x Montcalm and seventy-four pairs from Feebar x Kindred, each pair having been derived from a separate F_2 plant, were tested in the F_6 generation. The members of a pair were the result of positive and negative selection in the F_4 and F_5(generations with the main emphasis for this selection being apparent yielding ability. Replicated data were obtained in the F_6 generation for heading date, plant height, resistance to lodging, visual yield score, yield, 200 kernel weight, bushel weight and percent thins in both crosses. High early season temperatures followed by excessive rainfall resulted in an unusual amount of late tillering in some of the selections. The relative amounts of this late growth were estimated for the selections in the Feebar x Kindred cross.

The positive and negative selection practiced in the F_4 and F_5 generations affected most of the characters studied in both crosses except yield. In the Feebar x Kindred cross the differences between selections, though statistically significant, were not large enough to be of importance to a plant breeder whereas in the Feebar x Montcalm cross the differences between positive and negative selection were larger and more meaningful.

The F_3 lines from which the F_6 lines used in this study descended, were tested in a replicated trial by Peterson* in 1953. Correlation coefficients were calculated between Peterson's results and those obtained in the present study. The correlations were highest for heading date and were successively lower for plant height, 200 kernel weight, bushel weight, percent thins, yield, resistance to lodging and visual yield rating. There was little or no association between the F_3 and F_6 yields in the Feebar x Kindred cross but there was sufficient association in the Feebar x Montcalm cross to justify selection at the F_3 level.

Although many of the intercharacter correlations in the Feebar x Kindred cross were significant, few of them were large enough to be of much value. A high positive

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association was noted in this cross between heading date and the amount of secondary growth. In the Feebar x Montcalm cross there were good correlations between yield and the kernel characters.

A method for screening large numbers of lines by eliminating replication and placing a check variety in every fifth row was investigated. Adjustments of the data on the basis of the check performance proved of little value.

84 pages. $2.00.

*Peterson, G. A. 1956. A study of certain agronomic and malting quality characters of two barley crosses in the F_3 generation. M.S. Thesis, Univ. of Minn.

THE RELATIONSHIP OF VARYING SOIL OXYGEN CONTENTS TO SALT UPTAKE BY CORN

(Publication No. 25,419)

Raymond Elihu Shapiro, Ph.D.
The Ohio State University, 1952

The evaluation of the effect of a physical property of soil on plant growth necessitates an experimental technique that nearly limits the experiment to a single variable and duplicates soil conditions as nearly as possible. Thus an evaluation of the effect of soil oxygen content per se on salt uptake must divorce the effect of soil oxygen from the effects of compaction and flooding the root environment of the plant, which also influence the aeration of soils.

The experiments reported in this paper have three primary goals: (1) the development of an experimental technique wherein the various soil oxygen contents are maintained by a diffusion exchange of gas between the soil air and an external environment; (2) a nearly single variable evaluation of the effects of varying soil oxygen content on salt uptake by corn; and (3) a testing of the supposed alleviating effect of potassium fertilization on low oxygen content in the soil air.

Experimentation

Experimental Design and Soils Used

The soil used in this experiment was a Clermont silt loam showing a marked response to potassium fertilization. The soils were treated with a synthetic soil conditioner, C.R.D.-186 (a copolymer of vinyl acetate and maleic acid supplied by the Monsanto Chemical Company), at the rate of one ton per acre in order to maintain a highly porous soil structure and thus permit maximum gaseous diffusion throughout the course of the experiment. The design utilized to test the $K\text{-}O_2$ interaction was factorial in nature, having three levels of oxygen — high, 20 per cent oxygen; medium, 12 per cent oxygen; low, 5 per cent oxygen — and two levels of potassium — K_0 and K_1. The fertility rates utilized are given in Table 1.

Maintenance of the Various Oxygen Levels

Control of the oxygen content of the soil air was attained by control of the diffusion area between the soil air and the external atmosphere with a surface sealing mixture which formed a tight junction with the growing plants and the sides of the glazed pots. Before applying the seal, the stems of the corn plants were wrapped with a band of the sealing mixture about ½ inch thick and extending up one inch from the soil surface, which was then covered with a layer of gravel ½ inch thick. One inch watering funnels were then placed on the gravel layer. The gravel was thoroughly wetted before pouring in the sealing mixture, which was added in small amounts until the desired thickness was reached.

Table 1. Fertility Rates Used in Greenhouse Experiment

	$CaCO_3$ T/A	Mg Lbs/A	P Lbs/A	K Lbs/A	N Lbs/A	S Lbs/A
Clermont s. l. 1951	2½	100	77	130	60	
Clermont s. l. 1952			100	200	100	100/A

The 20 per cent soil oxygen content was maintained by cutting 10 holes with a No. 10 cork borer in the surface of the wax and leaving open the drainage hole at the bottom of the crock. In addition, glass funnels, two inches in diameter, were buried at various depths in the soil to serve as diffusion paths between the soil air and the atmosphere.

The 12 per cent oxygen content was maintained entirely by diffusion through the glass funnels which were left open to the atmosphere. The drainage hole at the bottom of the crock was plugged but not completely sealed with a rubber stopper.

The 5 per cent oxygen level was maintained by connecting the soil diffusion outlets, as constituted by the glass funnels, with an external atmosphere and completely sealing the drainage hole at the bottom of the crock.

Harvest and Analytical Procedures

The experiment was run for 27 days after imposition of the oxygen variable in 1951 and for 21 days in 1952, when the tops and roots were harvested, oven dried at 70° C, weighed, and analyzed for K, Mg, N, P, Ca, and Na. Standard analytical procedures were used.

Results and Discussion

Yields of Tops and Roots as Affected by Varying Soil Oxygen Content and Potassium Fertilization

The relationship of top and root yields to decreasing soil oxygen content and K fertilization are shown in Table 2.

Table 2.

	Average Dry Weight, Grams						
	Per Cent Oxygen Content				K	No K	LSD
	20%	12%	5%	LSD			
	1951						
Tops	10.0	9.2	5.5	1.6**	8.4	8.0	N.S.
Roots	2.8	2.5	1.4	0.5**	2.6	1.9	0.4**
	1952						
Tops	11.4	11.9	10.1	1.1**	12.6	9.6	0.9**
Roots	2.32	2.4	2.15	N.S.	2.50	2.08	0.28**

All $K\text{-}O_2$ interactions are non-significant.
**Least significant difference where F value exceeds 1 per cent level of significance.

During the course of the experiment, height measurements in 1951 indicated that potassium was a highly

significant factor in plant growth until the ninth day after application of the oxygen variable, but the final dry weight values for the tops were non-significant. The reason for this will be brought out in the discussion of the chemical composition of plant tops and roots.

The potassium-oxygen interaction for a soil low in exchangeable potassium was non-significant, since the marked potassium response at the highest oxygen level was of the same order of magnitude as at 5 per cent oxygen.

Chemical Composition of Roots and Tops as Affected by Varying Soil Oxygen Content and Potassium Fertilization

The results of the greenhouse work of 1951 showed that the percentage of Mg, P, N, and K in the leaf decreased with decreasing soil oxygen content, and the per cent composition of the roots increased with decreasing oxygen (see Table 3). The results in 1952 showed a similar trend.

Table 3. Chemical Composition of Plants, 1951

	Tops Per Cent Oxygen Content			
	20	12	5	LSD
% K	2.92	2.73	2.34	0.36**
% Mg	1.24	1.12	0.73	0.15**
% P	0.391	0.343	0.182	0.044**
% N	2.60	2.58	2.25	0.16**
% Ca°	1.49	1.42	1.51	N.S.
% Na	0.087	0.121	0.115	N.S.
	Roots			
% K	0.128	0.128	0.213	0.059**
% Mg	0.062	0.064	0.093	0.023**
% P	0.163	0.155	0.206	0.020**
% N°°	1.17	1.28	1.93	---
% Ca°	0.72	0.73	0.80	N.S.
% Na	0.154	0.102	0.135	N.S.

**Least significant difference where F value exceeds 1 per cent level of significance.

°Interaction significant at 5 per cent level.

°°Analysis made on composite sample.

The results given for chemical composition of roots in this experiment were different from those reported in the literature for excised root systems. The activity of the root systems of the experiments reported herein must be considered in relationship to the whole plant. The data in these experiments indicated that reduced oxygen in the soil air was affecting translocation of salts from the roots to the tops more than absorption of the salts into the roots themselves.

The lowest per cent K value (see Table 4) obtained in 1951 among the six treatments was 1.41 for the K_0-5 per cent O_2 treatment, but under similar greenhouse conditions 0.80 per cent K was the critical percentage for corn.

The total K uptake showed that plants grown under the K_0-20 per cent O_2 treatment contained about the same total K content as those grown under the K_1-5 per cent O_2 treatment. Yet the former yielded almost twice as much on a dry weight basis, indicating some other limiting factor than potassium. Examination of the phosphorus data (Table 4) showed a marked correlation between the percentage of phosphorus and the dry weight of tops: the phosphorus content was reduced by more than one-half by lowering the oxygen content of the soil air from 20 to 5 per cent. Thus, in 1951, phosphorus was probably the limiting factor in plant growth.

Table 4. Composition of Plants, 1951

	K_1-20	K_1-12	K_1-5	K_0-20	K_0-12	K_0-5	LSD
Tops (gms)	10.7	9.5	5.1	9.3	9.0	5.9	2.3**
% K	3.91	3.79	3.28	1.93	1.67	1.41	0.51**
Total K (mg)	413	356	167	178	146	82	49**
% P	0.388	0.321	0.169	0.394	0.366	0.195	0.065**
Total P (mg)	41.3	30.322	8.6	36.4	32.4	11.3	6.8**

**Least significant difference where F value exceeds 1 per cent level of significance.

Summary

A new technique was developed to maintain the oxygen content of the soil air at 20, 12, and 5 per cent oxygen by means of a diffusion technique.

The yield of the plant tops was significantly lowered by decreased oxygen content (5 per cent O_2) in the soil air, and the roots were significantly lowered or trend downward.

Decreasing soil oxygen content (5 per cent O_2) significantly reduced the percentage of K, Mg, P, and N found in the plant tops, but the per cent values for these elements in the roots either trends upward or was significantly higher with decreasing soil oxygen content. This indicated that low soil oxygen may affect the translocation of solutes from the roots to the tops rather than absorption of salts into the roots.

Other elements than potassium, particularly phosphorus, may be of importance in explaining reduced yields with decreasing soil oxygen content.

With a soil low in exchangeable potassium, the K-O_2 for yield of tops and roots was non-significant.

74 pages. $2.00. Mic 58-4773

Abstract published by special arrangement with The Ohio State University.

PHYSICO-CHEMICAL INVESTIGATIONS OF CLAY-ADSORBED ORGANIC COLLOIDS

(Publication No. 25,421)

Frank Jay Stevenson, Ph.D.
The Ohio State University, 1952

Progress towards the elucidation of soil organic matter has been unusually slow, both because of its complex nature and because, in general, soil chemists have attempted to characterize soil organic matter using simple analytical procedures. The purpose of the investigation was to apply some of the newer methods of physical and colloid chemistry to a study of soil organic matter. The investigation consisted of an electrophoresis examination to determine the number of electrically separable colloids extracted

from the clay fraction of the soil, and of a sedimentation velocity and free diffusion study to determine the size and shape properties of the humic acid fraction.

EXPERIMENTAL

The soils used in this study were the Brookston, Crosby, and Miami members of the Miami catena. The clay fraction (< 2 micron) was separated from the soil in the usual manner and the organic matter extracted with neutral sodium pyrophosphate solution. The extract was centrifuged to remove clay particles and then dialyzed against running distilled water to remove pyrophosphate solution and low molecular weight organic compounds. This preparation was refrigerated at 10°C until used for the electrophoresis, sedimentation velocity, and free diffusion studies.

Electrophoresis

In this investigation the moving boundary technique of Longsworth and MacInnes[1] was applied with the Tiselius-Klett electrophoresis apparatus. Refractive index patterns were obtained at pH levels of 4.8, 7.0, and 9.0 by means of acetate, phosphate, and borate buffers, respectively, and at ionic strengths of 0.1 and 0.02.

Mobility was calculated by the expression,

$$\text{Mobility} = \frac{V_e K_{sp} Q}{I}, \qquad (1)$$

where V_e is the velocity in cm/sec, I the average current in amperes passing through the cell, K_{sp} the specific conductivity, and Q the cross-sectional area of the cell.

Sedimentation Velocity Measurements

Sedimentation velocity measurements were made in an air-driven vacuum ultracentrifuge of the type developed by Pickles and Beams.[2] The rate of sedimentation was followed with the light absorption method.[3] The photographs of the sedimenting boundaries were analyzed by means of a Knorr-Albers microphotodensitometer with a Speedomax recording unit.

The sedimentation constant, s, was calculated from the equation,

$$s = \frac{2.3\ d\log X}{\omega^2\ dt}, \qquad (2)$$

where X is the distance of migration, ω the angular velocity in radians per second, and t the time.

The limiting value of the sedimentation constant was obtained by plotting the reciprocal of the sedimentation constant at three concentrations and extrapolating to zero concentration. The following relationship was used to convert the observed sedimentation constant, s_t, to a sedimentation constant, s_{20}, for a process occurring in water at 20°C.

$$s_{20} = s_t \frac{\eta_T\ (1-V\rho_{20})\ \eta\ (1-V\rho_0)}{\eta_{20}\ (1-V\rho_t)\ \eta_0\ (1-V\rho)}, \qquad (3)$$

where the symbols have been standardized.

Diffusion

The diffusion measurements were made in a Claessen-type diffusion cell by means of the Tiselius-Klett electrophoresis apparatus. Schlieren scanning patterns were obtained at regular intervals during the run and the diffusion constants calculated by the maximum ordinate-area method. The diffusion constant was calculated by the following relationship:

$$D = \frac{A^2}{H^2 m^2 4\pi t}, \qquad (4)$$

where A is the area under the curve, H the maximum ordinate, m the magnification factor, and t the time.

The value of the diffusion constant for a process taking place in an infinitely dilute water solution at 20°C was likewise obtained. The conversion was made by the formula,

$$D = D_t \frac{\eta_t\ 293}{\eta_{20}\ T}, \qquad (5)$$

where D_t is the measured diffusion constant at temperature T, η_t the viscosity of the solvent at temperature T, and η_{20} the viscosity of water at 20°C.

Partial Specific Volume

The partial specific volume, V, of the colloid was calculated from the equation,

$$V = \frac{1/\rho_{solu.} - (1-w_2)\,1/\rho_{solv.}}{w_2}, \qquad (6)$$

where w_2 is the weight fraction of the colloid and ρ is the density.

RESULTS

The electrophoresis study indicated that the organic matter associated with the clay fraction of the soil consisted essentially of a single mobile constituent, which is comparable to the results obtained earlier by Robinson.[4] Two additional mobile colloids were found to be present in small concentrations. The three components were detected in pyrophosphate extracts from all three soils.

The main component shown in the electrophoresis patterns is a dark-brown to black substance which corresponds to the humic acid fraction of the soil organic matter. The second and third components were not identified.

Representative electrophoresis patterns showing the three components detected in an extract from Miami clay are shown in Figure 1. The humic acid colloid is represented by the large peak in each pattern. One of the components present in small concentration has a mobility greater than humic acid and is shown in the ascending limb. The second minor component has a lesser mobility and is indicated in the descending limb. In the descending limb a peak is shown at the initial starting position, but this is the ε-boundary anomaly and does not represent a separate component in the mixture.

The mobilities of the humic acid component and one of the minor components are shown in Table 1. The measurements were made on the organic colloids extracted from Brookston clay.

The sedimentation velocity study showed that humic acid extracted from Miami clay was polydisperse with respect to particle size. This was seen in the photographs of the sedimentating boundaries (see Figure 2), where the

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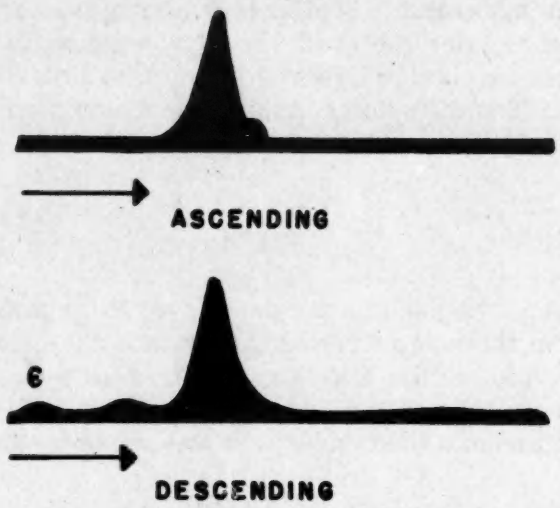


Figure 1. Representative electrophoresis patterns of colloidal organic matter extracted from Miami clay. The analysis was made at pH 9.0 and at an ionic strength of 0.1. The time was 68 minutes.

Table 1. Electrophoretic mobilities of the organic colloids extracted from Brookston clay with neutral sodium pyrophosphate solution. The main component is a dark-brown to black substance corresponding to the humic acid fraction of the soil organic matter. The second component has not been identified.

pH	Ionic strength	I x 10^2 amps	Ksp x 10^3		Velocity (mm/min)				Mobility* x 10^5 (cm^2 sec^{-1} $volt^{-1}$)	
			Buffer	Soln.	Main comp.		Second comp.			
					Asc.	Desc.	Asc.	Desc.	Main comp.	Second comp.
4.8	0.1	0.9902	2.315	2.398	0.48	0.46	—	0.25	13.6	7.1
7.0	0.1	1.7902	5.318	5.247	0.34	0.34	—	—	12.0	—
9.0	0.1	1.8000	5.840	6.030	0.36	0.36	0.45	—	13.4	17.4
4.8	0.02	0.2716	0.643	0.688	0.69	0.66	—	—	19.8	—
7.0	0.02	0.3972	0.556	0.643	0.87	0.86	—	—	18.2	—
9.0	0.02	0.5040	0.859	0.859	—	0.98	—	—	20.0	—

*Tabulated as an average value of the mobilities of the ascending and descending boundaries

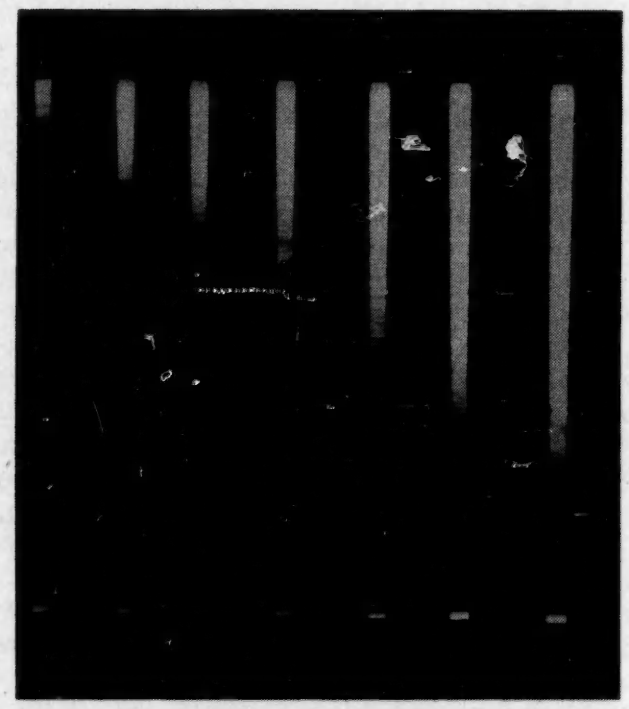


Figure 2. Band absorption patterns of humic acid extracted from Miami clay. The colloid is migrating from top to bottom. The bands were taken at 40 minute intervals covering a period of 5½ hours time. The speed of the rotor was 48,000 r.p.m.

gradients in photoblackening were found to be spread over relatively large distances.

The sedimentation constants are tabulated in Table 2. The value of the sedimentation constant for sedimentation taking place in an infinitely dilute water solution at 20°C was found by means of equation (3) to be 2.8 x 10^{-13} cm/sec/dyne.

Table 2. Sedimentation constants of humic acid extracted from Miami clay with neutral sodium pyrophosphate solution. The measurements were made in a phosphate buffer of pH 7.0 and an ionic strength of 0.1.

Concentration mg/ml	RPM	$\frac{d\log X}{dt}$ x 10^4	s* x 10^{-13} cm/sec/dyne
1.55	47,070	1.99	3.14
1.25	45,090	1.77	3.04
1.25	53,290	2.65	3.26
0.78	48,000	2.11	3.20
0.78	52,190	2.54	3.26

*The limiting value was calculated to be 3.2 x 10^{-13}.

The free diffusion study also indicated that the colloid was polydisperse. This indication of polydispersity was obtained from a comparison of the normalized diffusion curves of several representative patterns, with the ideal Gaussian distribution curves having the same standard deviation, where it was found that the curves for the colloid had greater maximum ordinates than the ideal Gaussian curves.

The diffusion constants are given in Table 3. The limiting value for use in molecular weight calculations was taken as an average of the diffusion constants for concentrations of 1.55 and 1.25 mg/ml. This figure was 3.6 x 10^{-7} sq cm/sec.

Table 3. Diffusion constants of humic acid extracted from Miami clay with neutral sodium pyrophosphate solution. The measurements were made in a phosphate buffer of pH 7.0 and an ionic strength of 0.1.

Concentration mg/ml	Time x 10^{-4}	H cm	A* sq cm	D x 10^7 sq cm/sec
1.55	4.56	1.60	0.70	3.34
	8.18	1.20	0.73	3.41
	10.68	1.10	0.68	3.64
	12.75	0.92	0.71	3.80
	16.77	0.82	0.71	3.62
1.25	4.86	1.20	0.58	3.81
	5.80	1.15		3.48
	6.90	1.00		3.88
	7.29	1.00		3.68
	9.21	0.88		3.75
0.78	3.90	0.90	0.39	3.74
	4.86	0.75		4.32
	5.80	0.70		4.17
	6.90	0.70		3.50
	9.21	0.55		4.25

*Areas for the lower concentrations are the average of several determinations

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The diffusion constant for diffusion taking place in an infinitely dilute water solution at 20°C was calculated by means of equation (5) to be 3.9×10^{-7} sq cm/sec.

The partial specific volume of the colloid was found to be 0.67. The value of the quantity $(1-V\rho)$, which is required in the molecular weight equation, is 0.33.

CALCULATIONS

The molecular weight is calculated from sedimentation velocity and free diffusion data by the formula,

$$M = \frac{RT\ s}{D\ (1-V\rho)}, \qquad (7)$$

where R is the gas constant.

The limiting value of s_{20} for humic acid extracted from Miami clay is 2.8×10^{-13} cm/sec/dyne. The corresponding diffusion constant is $D_{20} = 3.9 \times 10^{-7}$ sq cm/sec. The value of the quantity $(1-V\rho)$ is 0.33. Thus,

$$M = \frac{8.314 \times 10^{7} \cdot 293 \cdot 2.8 \times 10^{-13}}{3.9 \times 10^{-7} \cdot 0.33} = 53{,}000.$$

From the molecular weight the molar frictional coefficient was computed to be $f = 6.25 \times 10^{16}$. For a spherical particle of the same size the frictional coefficient is $f_o = 2.76 \times 10^{16}$. The molar frictional ratio (f/f_o) is 2.3. This ratio suggests that the colloid is non-spherical and/or solvated.

DISCUSSION

The organic colloids extracted from the clay fraction of the soil with neutral sodium pyrophosphate solution consists essentially of humic acid, two other mobile colloids being present in trace amounts only. The humic acid component migrates as a single electrically separable colloid under the influence of an electric current. However, the peak for humic acid in the schlieren scanning patterns became very broad after two hours at 1.0 volts/cm, indicating a considerable degree of electrophoretic inhomogeneity. The second and third components were difficult to identify for this reason.

From the information which has been obtained from the electrophoresis, sedimentation velocity, and free diffusion experiments it has been possible to arrive at some conclusions as to charge, polydispersity, particle shape, and molecular weight of humic acid extracted from Miami clay with neutral sodium pyrophosphate solution. The colloid can best be described as consisting of short, compact molecules of varying particle sizes, and with unequal charge densities on the surface. The value of the molecular weight was found to be 53,000, which is believed to correspond to a weight-average molecular weight or a value between a weight-average and a Z-average.

The frictional ratio of humic acid was 2.3, which Svedberg and Pedersen[5] list, on the basis of no hydration, as having an axial ratio of 30 to 1. It is probable, however, that the colloid is hydrated and has an axial ratio less than 30 to 1. The degree of hydration of the colloid has not yet been determined.

The results of this investigation have demonstrated that the techniques used here can serve as valuable experimental tools for the determination of the physical and chemical properties of soil organic colloids.

95 pages. $2.00. Mic 58-4774

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Abstract published by special arrangement with The Ohio State University.

PHOSPHORUS SUPPLYING CAPACITIES OF SOME OHIO SOILS

(Publication No. 25,423)

Lyell Floyd Thompson, Ph.D.
The Ohio State University, 1952

INTRODUCTION

Phosphorus exists in the soil in many different chemical forms. It is combined into organic and inorganic forms, and most of the soil phosphorus compounds release phosphorus into forms that can be utilized by plants. This study is an attempt to ascertain the nature of the compounds in Ohio soils which are important in providing plants with phosphorus.

EXPERIMENTAL

Greenhouse Experiments

Bulk quantities of soil chosen to represent the major soil types in Ohio were collected and used in two greenhouse experiments set up to provide data concerning the phosphorus supplying capacities of the soils.

In the first experiment quantities of air dry soil equivalent to 3.0 kgm. of oven dry soil were limed to a pH of 7.0 and potted. One-half gram of 18 per cent superphosphate containing P^{32} was sprinkled evenly on 1.5 kgm. of soil, after which the other 1.5 kgm. of soil was added to the pot. The pots were prepared in triplicate. On April 21, the pots were planted and five corn plants were permitted to grow in each pot. After the plants emerged they were fertilized with a phosphorus free liquid fertilizer solution.

On June 15, the corn plants were harvested, then dried, weighed and analyzed for total and radioactive phosphorus.

In a second greenhouse experiment involving alfalfa the pots were prepared in the same way as those for corn except that no phosphorus was added to the soil. On November 30 each pot was seeded with Southern California Common alfalfa. On April 11 the first harvest was taken, and subsequent cuttings were made periodically until September 16, when the fifth and last harvest was made.

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After the last harvest the roots were removed from the soil. The soils were fertilized with additional potassium after each alfalfa cutting. The alfalfa tissue was dried, weighed, and analyzed for phosphorus.

Laboratory Experiments

The laboratory phase of this problem involved soil phosphorus extractions by various chemical methods. It was reasoned that each of the chemical extractions used would remove phosphorus from different soil phosphorus compounds.

The Bary (1) extraction composed of 0.03N NH_4F in 0.1N HCl was used as a measure of the exchangeable soil phosphorus. The method of Truog (2), employing 0.002N H_2SO_4, was used as a measure of the weakly acid soluble soil phosphorus. An extraction of organic phosphorus was made by heating one gram of soil in 100 milliliters of one per cent potassium carbonate at 90° C. for one hour. The organic phosphorus in the digest was hydrolyzed and determined. An ammonium citrate extraction of the soil was made and both inorganic and organic phosphorus was determined on the extraction.

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RESULTS AND DISCUSSION

From a knowledge of the quantity of radioactive phosphorus added to the corn pots, and the total and radioactive phosphorus content of the corn, it is possible to calculate the "A" values of the corn with the formula:

$$(1)\quad \frac{A}{B} = \frac{1-Y}{Y}.$$

"B" is the quantity of phosphorus added to the soil and "Y" is the added phosphorus expressed as the percentage of the total in the plant tops. "A" is a constant for any particular soil and plant, and its units are the same as those of "B."

Table 1 gives the "A" values calculated from the corn, and the phosphorus released from the soil to five cuttings plus roots in the alfalfa experiment. The phosphorus released to the four laboratory extraction solutions is also given in Table 1. The correlation coefficients between phosphorus release to plants versus release to chemical methods is given in Table 2.

Most of the laboratory extraction methods yielded quantities of phosphorus that were correlated highly with the quantities released to plants. In all of the correlation studies used the same number of soils were used; therefore, the correlation coefficients can be directly compared. The highest regular correlation coefficient secured was 0.835. Perhaps this is as high a correlation as can be hoped for with phosphorus studies such as this, but potassium investigations similar to the one undertaken here may give correlations well above 0.9.

A multiple regression coefficient was calculated to see if the amount of phosphorus found in the plants showed any relationship between the amounts of inorganic plus organic phosphorus removed from the soil by different chemical extractions. The multiple regression compared the amount

TABLE I

Soil series, phosphorus released by four laboratory extractions, "A" values of corn, and phosphorus released by soils to alfalfa in five cuttings plus roots. Reported as ppm. P.

Soil No.	Soil series	0.03N NH_4F soluble P	0.002N H_2SO_4 soluble P	K_2CO_3 extracted organic P	ammonium citrate extracted		"A" values	P released to alfalfa
					inorganic P	organic P		
17	Trumbull	66.5	72	396	32.2	23.2	285.85	75.76
14	Lake Brookston	64.5	132	207	13.1	4.9	128.59	35.86
4	Clyde	57.0	88	233	16.9	4.7	105.02	40.23
6	Brookston	52.5	108	266	16.9	3.8	120.55	40.76
7	Miami	39.5	48	90	21.3	9.7	51.17	34.90
16	Ravenna	37.5	45	339	16.3	8.1	150.02	57.66
8	Miami	30.5	44	93	9.4	3.4	59.47	26.36
1	Brookston	28.5	60	207	6.6	3.8	88.94	24.43
12	Alexandria	28.0	36	139	6.6	14.1	71.80	42.50
10	Rossmoyne	24.0	21	202	8.1	8.8	61.35	40.10
3	Clermont	23.0	22	124	15.0	6.6	121.36	39.93
5	Miami	19.0	20	110	7.5	0.9	79.03	30.63
2	Miami	19.0	16	113	6.9	3.8	53.85	25.76
11	Marengo	18.5	28	260	6.3	8.0	65.37	38.20
15	Wooster	15.0	18	137	6.9	14.9	54.65	34.93
9	Russell	14.5	16	126	7.8	2.5	57.87	29.96
18	Mahoning	14.5	17	67	3.8	9.1	39.65	28.86
13	Wellston	8.0	12	83	3.1	8.8	34.02	15.30

TABLE II

Correlation coefficients of the phosphorus removed from soils by greenhouse cropping and phosphorus extracted by chemical analysis.

	0.03N NH_4F soluble P	Total organic P in K_2CO_3 extract	NH_4F citrate extractable		0.002N H_2SO_4 soluble P
			inorganic P	organic P	
"A" values	.748	.784	.833	.491	.520
Total P removed in five cuttings plus roots in alfalfa experiment	.632	.816	.816	.649	---

$r_{.05} = .468$
$r_{.01} = .590$

of phosphorus contained in five cuttings plus roots of alfalfa with the inorganic phosphorus removed from the soil by the 0.03N NH_4F extraction and the organic phosphorus removed by the one per cent potassium carbonate. The equation of the multiple regression is of the form,

$$(2)\quad \hat{Y} = C + C_1X_1 + C_2X_2.$$

$\hat{Y}$ is the estimated quantity of phosphorus released from the soil to alfalfa, X_1 is soil inorganic phosphorus extracted by 0.03N NH_4F, and X_2 is the organic phosphorus extracted by potassium carbonate. The calculated equation is:

$$(3)\quad \hat{Y} = 14.447 + 0.1258X_1 + 0.1033X_2$$

$$R = .8845\ .$$

This correlation coefficient is significant at the one per cent level. The agreement between the true Y and the calculated $\hat{Y}$ of this equation is shown in Figure 1.

To test the significance of this multiple correlation

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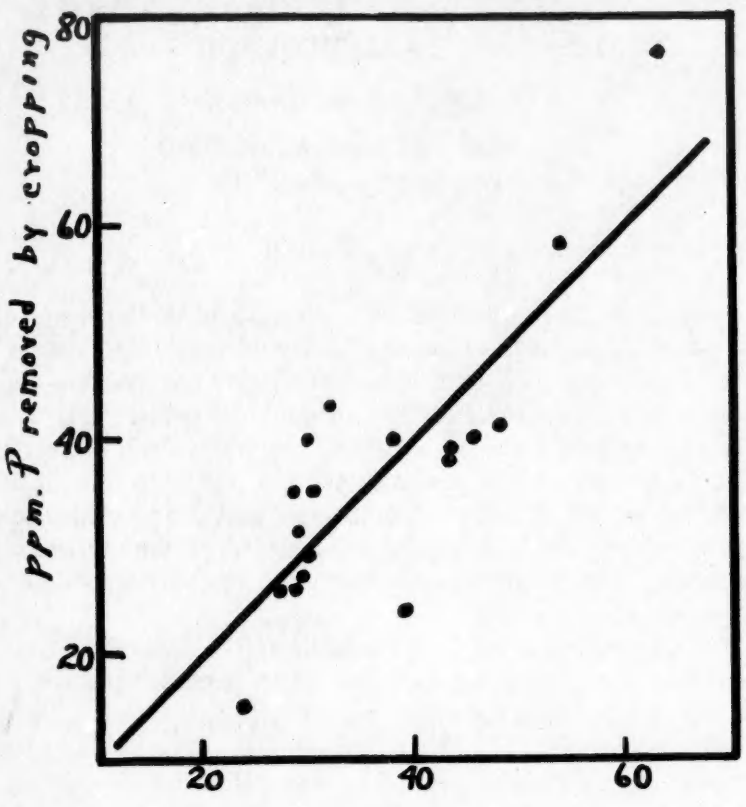


Figure 1. Relationship between P removed from 18 soils by cropping with alfalfa in greenhouse and estimated P removed.

The estimated values were calculated using $\hat{Y} = 14.447 + .1258X_1 + .10326X_2$, where $\hat{Y}$ = estimated P removed by cropping, X_1 = Bray soluble P in soils before cropping and X_2 = organic P removed from soil by one per cent potassium carbonate.

coefficient, it was compared with the simple correlation coefficients secured by correlating Y versus X_1, and Y versus X_2. The "F" test was used in this test of significance. The multiple correlation coefficient was significantly higher at the one per cent level than the correlation coefficient secured by correlating phosphorus released to alfalfa versus phosphorus extracted by 0.03N NH_4F. The multiple correlation coefficient was significantly higher at the five per cent level (and closely approached the one per cent level) than the coefficient secured by correlating the phosphorus released to alfalfa with the organic phosphorus extracted by potassium carbonate. Most soil tests remove phosphorus that exists in only one form, and therefore a chemical extraction will not remove phosphorus from all the forms that are available to plants. Certain chemical extractions were employed more successfully than others; however, no single extraction appears to be highly superior to all others. This perhaps indicates that the soil phosphorus which is, or becomes, available to plants exists in several unrelated forms in the soil. The phosphorus extraction methods that extract phosphorus by replacement or exchange reactions appear to have greater value than those based upon acid dissolving action.

It is interesting to note that in the correlations reported in Table 2 the inorganic phosphorus extractions were more closely related to the quantities of phosphorus released to corn than to alfalfa. Conversely, extractions of organic phosphorus are in better agreement with the phosphorus released to the alfalfa. During an extended period of time these results indicate that mineralized organic phosphorus compounds may be of considerable importance to plants.

The phosphorus removed by the ammonium citrate extractions also agrees well with the phosphorus removed by the plants. The citrate molecule had a strong combining power for the ferric and aluminum ions. It is believed that the citrate ion complexes the ferric and aluminum ions, thus releasing the phosphorus that was held in combination with the iron and aluminum. This phenomena seems especially feasible in soils having a pH of 6.0 or less.

The role of the citrate ion in soil phosphorus extraction studies deserves more study and perhaps more application in the field of soil science. Perhaps it will be possible to use the citrate ion in phosphorus extraction work and predict the quantities of inorganic and organic phosphorus in a soil that are, or will become, available for plant use. An assay of the inorganic nitrogen in the soil would be of no value in predicting the quantity of nitrogen a soil will liberate to plant use. From 20 to 50 per cent or more of the total phosphorus in the top soil is in the organic form. This phosphorus, which is an important source to plants, must be reckoned with.

In recent years certain investigators have contended that in some soils a phosphorus extraction devised to remove exchangeable phosphorus gives a truer value of the phosphorus fertility of the soil. Tests that are based upon the removal of exchangeable phosphorus are usually more applicable in acid soils. It is true that the 0.002N H_2SO_4 soluble phosphorus was of little value with the soils studied here. The reaction of the soils used in this study was considerably higher than the agricultural soils of the state in general.

SUMMARY AND CONCLUSIONS

Eighteen Ohio soils were obtained and used in greenhouse and laboratory phosphorus extraction studies to determine the nature of phosphorus compounds in Ohio soils which release their phosphorus to plants.

Correlation coefficients were calculated on plant versus laboratory extraction of phosphorus.

The results of these investigations lead to the following conclusions:

1. The plant available soil phosphorus originates from several different chemical forms.
2. No single laboratory extraction will release quantities of phosphorus that will show an extremely close relationship to the quantities removed by plant extraction.
3. There are a number of laboratory methods that show a good general relationship between laboratory extraction and plant extraction of phosphorus.
4. Soil extraction methods based upon liberating exchangeable phosphorus are more applicable to Ohio soils than extractions employing 0.002N H_2SO_4. This is true even though the soils have high pH values.
5. The phosphorus utilized by plants comes from both the inorganic fractions and from organic compounds that are rather easily extracted and hydrolyzed.

65 pages. $2.00. Mic 58-4775

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AGRICULTURE, ANIMAL CULTURE

A STUDY OF THE RELATIONS OF GRANARY INSECTS TO THE OCCURRENCE AND ABUNDANCE OF STORAGE MOLDS OF GRAIN

(L. C. Card No. Mic 58-1102)

Narayan Swarup Agrawal, Ph.D.
University of Minnesota, 1957

Adviser: A. C. Hodson

It has been shown that all the life stages of granary weevil, except the egg, carry on and inside their bodies spores of storage molds in general and Aspergillus restrictus in particular. This association has been observed for the first time. When surface-disinfected weevils were kept in Marquis wheat, the moisture content of wheat increased as the weevils started multiplying in it and so did the molds, especially A. restrictus. When by forced aeration the moisture content of wheat was kept constant at very nearly 15%, molds still developed faster and more numerously than in the checks. When starved and surface-disinfected weevils were kept in autoclaved wheat, A. restrictus and A. repens developed quite heavily while checks remained mold free.

Molds developed faster at 30°C. than at 25°C. in association of the weevils. However, they could not grow at low moisture, for example, at a constant moisture content of 12-13%, even though weevils were present. But the spores were always found in the frass, even though they could not develop on wheat.

The progeny of 500 granary weevils could increase the moisture content and mold count to an appreciable amount in a period of 7 months, when kept in one-half bushel of wheat at laboratory temperature and humidity. When 400 weevils were confined in a bag filled with wheat and were kept in the bottom of 3 x ½ ft. column of wheat, the moisture content and mold count not only increased where the weevils were present but also 6 - 12 inches away from the site of infestation.

The rice weevil, like the granary weevil, carries storage molds, increases the moisture content of wheat but much faster and creates favourable conditions for the growth of molds which need more moisture for growth and development.

The lesser grain borer, though it carries some of the storage fungi, does not cause any appreciable increase in moisture content. However, molds do grow faster in association with the beetles than in the checks.

Life stages of the confused flour beetle, saw toothed grain beetle, and Indian meal moth were cultured on different agar media. Various storage molds along with bacteria and yeasts grew out of their bodies.

Grain mites (Tyroglyphus farinae) carry on and inside their bodies the storage molds and provide conditions suitable to their growth and development.

The storage pests, besides providing suitable growth conditions to molds, give protection as well as effective means of dissemination. 92 pages. $2.00.

MENHADEN AND PILCHARD OILS AS CALORIC SUPPLEMENTS FOR SWINE

(Publication No. 24,622)

Allen Francis Anglemier, Ph.D.
Oregon State College, 1957

Major Professor: James E. Oldfield

Fats and oils produced as by-products of the meat and fish packing industries have readily accumulated into a burdensome surplus in the past few years. The development of new uses for fats and oils would reduce this surplus and stabilize their declining market value. Their use in farm livestock rations may offer a possible new outlet.

Although the literature indicates that dietary fats and oils have both caloric value and beneficial non-caloric functions, objections are encountered in the use of certain oils when fed to swine.

Crude pilchard oil was found to cause a marked decrease in the quality of carcass fat in terms of color, odor and hardness when fed to growing-fattening swine at a dietary level of 2.75 per cent or higher. These objections were not remedied by feeding a non-pilchard oil containing ration as long as 13 weeks subsequent to the feeding of the highest level of fish oil, although such feeding did apparently increase the hardness of the fat.

Certain laboratory procedures employed to decolorize and deodorize the crude pilchard oil were partially effective. Rats were found not to be suitable subjects for studying the transfer of fish oil pigments to the depot fat when the fish oil was fed at a 5 per cent level.

Crude and alkali washed, bleached menhaden oils when fed at a dietary level of 5 per cent caused an undesirable fishy odor and imparted a slight brownish tinge to the carcasses; however, the objectionable features were not as marked as in the carcasses of the pigs fed pilchard oil.

Carcasses from the pigs fed 5 per cent polymerized menhaden oil were practically indistinguishable from the controls, although in some cases an objectionable cooking odor was noted. The cooked meat from these animals was judged as equal to that of the controls. Growth rate and feed efficiency were depressed in pigs fed the polymerized oil. In view of these facts, it may be possible to modify the polymerization process to improve the nutritional qualities of fish oil without interfering with its effects on the carcass quality of fed animals.

126 pages. $2.00. Mic 58-4776

EFFECTS OF SEX AND AGE OF MALE CASTRATION ON GROWTH AND CARCASS QUALITY IN YORKSHIRE SWINE

(L. C. Card No. Mic 58-1110)

Laurent Armand Charette, Ph.D.
University of Minnesota, 1957

Gilts, boars, and males castrated at birth, 6, 12, 16, and 20 weeks were compared to determine the effects of sex and age of male castration on growth and carcass quality in Yorkshire swine. No pigs died on account of castration. Individual live weights and body measurements

taken at weekly intervals from birth to weaning, and at bi-weekly intervals thereafter, were not affected by sex or age of castration. The average daily gains from birth to market weight at 205±5 pounds were 1.32 pounds for gilts, 1.33 for 6-week castrates, 1.34 for 16-week castrates, and 1.35 for birth castrates, 12-week castrates, and boars. Although not significant, castration had a slight effect on gains made one or two weeks following the operation; but such animals caught up with the others three to four weeks after castration. The 315.4 pounds of feed required by boars per 100 pounds of gain was significantly less than that of 343.2, 347.0, 361.9, 350.0, and 359.3 required by gilts and barrows castrated at birth, 6, 12, and 16 weeks. The females reached market weight in 155.1 days and, although not significant, it was 3.2 to 5.7 days later than the boars or barrows castrated at different ages.

There was no significant difference in area of loin or shrinkage in carcass weight, but a number of carcass characteristics were affected by either sex or age of castration. Barrows castrated at 6 weeks yielded more in carcass weight than all lots except birth castrates and gilts, and more than all in dressing percentage except birth castrates. Gilts and boars produced the longest carcasses. Carcasses of boars were noted for their thinness of fat, whereas the barrows castrated at birth and 6 weeks had the highest fat measurements. Females and entire males showed less fat at the shoulders than did barrows. In back fat, the boars were thinner than the gilts and the barrows; in addition, the gilts and males castrated at 12 and 16 weeks had less fat than the birth and 6-week castrates. In loin fat, the boars were thin and excelled all other lots except the 12-week castrates which, for unknown reasons, had less fat than the gilts and barrows castrated at birth or 6 weeks. Although most carcasses were considered to have firm fat, and age of castration had no effect, boars yielded a softer fat than did gilts and barrows, gilts a softer one than did barrows castrated at birth and 6 weeks. All pigs were too heavy in shoulder, too light in ham and, except for the 6-week castrates, too light in middle. The latter yielded less percentage of ham than the other males and the gilts. Barrows castrated at 6 weeks obtained the lowest carcass score. With respect to acceptability tests, sex or age of castration caused no significant difference. The breeders can delay castration for better selection of boars without any serious effect on growth, physical carcass characteristics, or feed requirements.

The market still discriminates against boars and although it is not suggested that commercial producers should raise such animals to market weight, the feed efficiency, length of carcass, thinness of fat, and area of loin of the boars are worthy of consideration. When slaughter takes place at 200 pounds and before a boar reaches 150 days of age, it appears questionable whether castration is necessary. 123 pages. $2.00.

CHARACTERIZATION OF RENNIN

(Publication No. 24,629)

Chi-K Chuan, Ph.D.
Oregon State College, 1957

Major Professor: G. A. Richardson

The action of rennin on milk has been investigated for more than half a century, but the actual mechanism of milk coagulation remains unsolved. A number of investigators such as Hankinson, Berridge, De Baun, Oheda and Kasai, and others, have crystallized rennin from commercial rennet extract, but the purification methods were rather complex and time consuming, the yield was rather low and the crystalline preparations appeared to contain more than one component when examined by electrophoretic methods.

Partially purified rennin was isolated from commercial rennet extract by repeated, serial precipitations with increasing concentration of ethanol, the final concentration being 76 per cent. This rennin was dried to powder form either by lyophylizing or under vacuum at room temperature. The first fraction (I), in dry form contained approximately 100 per cent of the activity of the initial concentrate. The purest fraction (V or VI) contained 59.4 rennin units per mg. of nitrogen. This activity was ten times that of the initial rennet extract. The total recovery was 62% of the original, which is higher than any previously reported. Fraction IV showed slight proteolytic activity.

Various other organic solvents, such as methanol, propanol-1, propanol-2, acetone, dioxane were also used to precipitate the rennin. Of these methanol and propanol-2 were most satisfactory.

When distilled water and 2.5% NaCl solution were used as solvent for Fraction I the activity was increased by freezing, the longer the storage the greater the increase in activity.

Paper electrophoretic analysis indicated that the purified Fraction IV contained two main components, one having an isoelectric point between 4.50-5.0, the other between 6.6-7.0. In Fractions V and VI, however, only one component appeared.

When progress of milk coagulation by rennin was followed with the electron microscope, caseinate particles were seen to first agglomerate into particle-wide fibrils. These in turn condensed into bundles of fibrils.

The action of rennin and pepsin appears similar as shown by electrophoretic patterns of paracasein by rennin and 'paracasein' by pepsin. The changes in -SH groups, as determined by amperometric titration, during milk coagulation by rennin and by pepsin were found to be similar. When the coagulation time of skim milk, by rennin or pepsin, was adjusted to less than 10', the -SH groups increased rapidly within 30"-1'30" after the addition of enzyme and then decreased gradually to a minimum just before coagulation occurred.

From the milk coagulation phenomenon observed under electron microscope and the changes in -SH groups as determined by amperometric titration, the mechanism of milk coagulation by rennin may be considered similar to the modern concept of blood coagulation in which a sulfhydryldisulphide chain reaction is involved. It is postulated that two main reactions may take place in milk coagulation. The first consists of a rapid unfolding of the calcium caseinate molecules; the second involves slow

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aggregation, probably in association with colloidal calcium phosphate, to form a gel structure with milk serum as the continuous phase. The latter is released as whey as the curd shrinks. 99 pages. $2.00. Mic 58-4777

FACTORS INFLUENCING SEMEN QUALITY AND REPRODUCTIVE EFFICIENCY IN RAMS

(L. C. Card No. Mic 58-1264)

Edward Almon Nelson, Ph.D.
Kansas State College, 1958

Seasonal variations in ram fertility and the adverse effects of high environmental temperatures on semen production have been observed and reported by numerous research workers.

Four breeds of rams were observed in this study in regard to semen production during the summers of 1955, 1956, and 1957. Two rams of each breed were used for breeding experimental commercial ewes. During the last two years, additional rams not in active breeding service were observed. In 1957 the 12 rams which were studied were divided into control and daytime cooling treatments. The latter were subjected to cooling 8½ hours each day during the summer breeding season.

Eight rams were observed for seasonal variations in semen production during the fall, winter, and spring of the 1956-57 season.

Semen was collected from the vaginas of ewes during 1955. The artificial vagina was used for semen collection the last two years. The semen characteristics measured were semen motility, ejaculate volume, sperm concentration, and percentages of abnormal spermatozoa.

Lambing and breeding data were used as measures of ram fertility in those years the data were available.

Environmental temperatures were recorded at 5:00 p.m. each day in both the barn and cooled room in which the rams were housed.

The lambing and breeding data, on experimental ewes, indicate that ewes bred to Hampshire and Suffolk rams conceived and lambed earlier than those bred to either Shropshire or Southdown rams. The highest percentages of barren ewes were observed in the groups of ewes bred to Shropshire rams in 1955 and to Southdown rams in 1956.

For average semen motility score the breeds of rams were ranked as follows: Hampshire; Suffolk; Southdown; and Shropshire. On the basis of average ejaculate volume the breeds ranked as follows: Suffolk; Hampshire; Shropshire; and Southdown.

The rams in active breeding service and subjected to cooling treatment showed greater average improvement in fertility during the summer than did other treatment groups of rams. Progressive improvement in semen quality during the summer was more noticeable in rams not in active breeding service than those which were used to breed ewes.

The high summer temperatures seemed to cause detrimental effects on semen production. The maximum daily temperature appeared to have a greater influence on semen evaluation scores during 1956 than did the average weekly temperature. In 1957 the average weekly temperature appeared to have the greatest influence on semen characteristics.

Seasonal changes during the year other than the summer period, indicated generally medium to high ram fertility from September through the middle of December. The rams were considered to be low in fertility during the first 3½ months of the year. There were pronounced fluctuations in semen fertility scores from April 15 through May.

The correlation coefficients between semen motility and each of the other semen characteristics studied were highly significant.

The semen quality evaluations declined significantly during the first week of the breeding season. Improvement occurred during the following weeks, however, initial semen quality was not regained by some rams until late in the breeding season. 89 pages. $2.00.

AGRICULTURE, FORESTRY AND WILDLIFE

THE STATUS OF FEDERAL LAND GRANT LANDS IN UTAH AND PROPOSALS FOR THEIR MANAGEMENT

(L. C. Card No. Mic 58-994)

Arthur Dwight Smith, Ph.D.
University of Michigan, 1957

The study was undertaken to inquire into the status of the lands that remain of those which were given to Utah by the federal government upon statehood in 1896. Of the 7.5 million acres authorized under grants to the common schools and other public institutions, nearly 3 million acres are now held by the state. Another 1 million acres will be available when the remainder of the state is surveyed.

Analyses of the condition of the lands now under state control reveal that marked reduction in the forage crop has attended the years of grazing use. Forage is the principal surface resource on the land. The reasons for the conditions found are: (1) the desert character of the lands, most of them receiving less than 10 inches of annual precipitation; (2) the scattered nature of the land and their position amongst lands of other ownerships; (3) the lack of continuity in the form and personnel of the Utah State Land Board; (4) the lack of land-management training on the part of the employees of the land department; and (5) the absence of a well-defined land policy, but one objective having been sought in the past--sale of the lands to individuals.

The lands that remain are of low economic value, and many are chiefly important for their public values. This public importance is to be found in the fact that water is the most important product on many areas, a product whose yield is closely related to the treatment accorded the lands. Under too heavy and unsupervised use, the relatively sparse plant cover deteriorates, giving rise to rapid runoff and costly floods. Additional public values are to be found in the recreational values present and the game animals produced upon the lands.

A review of land administration in Utah failed to reveal evidence for the superiority of any one ownership as

evidenced by the condition of lands. Lands of the kind under consideration have undergone various degrees of deterioration under all ownerships. It is concluded that continued state ownership is the most desirable.

A land policy is proposed for the remaining lands. The major feature of this policy is the adoption of a philosophy toward the lands which would stress their use in the public interest. Land should be sold only to improve ownership patterns thus aiding in land administration.

To assist in the implementation of this policy, a series of zones were drawn covering the state of Utah. The zones evaluate the public importance of land. The factors used to establish these zones were recreation, hunting, and water production. These factors were assigned index values based upon proximity to population centers and altitude. The index values of the three resources were combined and lines drawn to connect points of equal value. The zones which thus result are called isorropic zones. Land within any one isorropic zone exhibits essentially equivalent public values. In the higher index zones, the state lands should be managed primarily for the enjoyment of the public. In the zones with lower values, private ownership may be acceptable. The possible uses of the land are assigned priorities within each isorropic zone.

To further the land policies proposed, a Land and Forestry Commission is outlined. This commission would assume the present functions of the Forestry and Fire-Control Board and the Land Board, except the supervision of the land funds. The Finance Commission would invest the land funds. The new organization would be divided into four functional divisions--lands, forestry, minerals, and parks. The latter one is new, no organization in Utah at present being charged with planning for the recreational needs of the state. 173 pages. $2.30.

THE INFLUENCE AND IMPORTANCE OF DEFECTS AND LOG GRADES ON LUMBER GRADE YIELD FROM ASPEN LOGS

(L. C. Card No. Mic 58-1166)

Walter Basil Wallin, Ph.D.
University of Minnesota, 1957

Major Adviser: Ralph Hanfeld

This study was designed to evaluate the externally apparent defects of logs in terms of product yield. Three grades for aspen logs have been previously suggested by the Lakes States Forest Experiment Station based on the Forest Products Laboratory log grade rules modified to allow for the small size and short length. Four-hundred forty-one eight-foot aspen logs varying in diameter from six to sixteen inches were selected to include all types of defects. The logs were graded in accordance with both the Lakes States Forest Experiment Station and the Forest Products Laboratory log grade rules. Neither was found satisfactory for differentiating the logs in terms of quality. After recording external characteristics, the logs were gang sawn into 6/4 lumber which was graded in accordance with the National Hardwood Lumber Association grade rules, and finally processed into crating material.

Quality index values were determined for each log, employing price relatives for basswood. It was found that to obtain realistic values for the aspen, the current mill-run price must be considered as an average No. 2-3 Com. price.

The logs were ranked numerically by quality index in descending order and divided into three quality classes. The class of highest quality logs included those which combined the highest yield of No. 1 Com. & Better lumber with the least yield of No. 2 Com. & Poorer. The class of intermediate quality logs included those which combined the highest yield of No. 2 and No. 3A Com. lumber with the least yield of No. 1 Com. & Better and the least yield of No. 3B Com. & Poorer. The class of lowest quality included those logs which combined the highest yield of No. 3B Com. lumber with the least yield of No. 3A Com. & Better. Thus, quality index ranges for the three quality classes outlined were 85 to 144%, 45 to 90%, and 0 to 55%.

The external characteristics were then analyzed for each of the quality classes. Log grades were defined in terms of diameter, size of clear area on the surface, and permissable decay. The analysis of external characteristics showed that these criteria served best to describe the logs contained in each of the defined grades.

To serve as a check on the validity of the defined rules as a measure of value for crating purposes, the product yield from each lumber grade was evaluated. It was found that the standard hardwood lumber grades serve as a measure of quality of the lumber for crating. Since the log grades were also defined in terms of the yield of lumber by the standard hardwood lumber grades, the defined log grades serve as a measure of the value of the log for crating use. 217 pages. $2.85.

AGRICULTURE, PLANT CULTURE

GENETIC ANALYSIS OF TEN SOURCES FOR HESSIAN FLY RESISTANCE, THEIR INTERRELATIONSHIPS AND ASSOCIATION WITH LEAF RUST RESISTANCE

(L. C. Card No. Mic 58-1260)

Robert Emerson Allan, Ph.D.
Kansas State College, 1958

The hessian fly is one of the most destructive insects that attacks wheat. The only reliable control measure is the use of resistant varieties.

This study involved the inheritance of resistance to hessian fly, the inheritance of resistance to leaf rust, and the relationships among different sources of hessian fly resistance in Tritium (wheat).

Three crosses were studied in the F_3 and F_4 generation for their reaction to several races of leaf rust and three strains of hessian fly. In the cross Comanche-Oro-Tenmarq X selection 52400, (Chiefkan-Hard Federation-Kawvale X PI 119344-7), a single factor controlled resistance to both eastern and western strains of hessian flies. Segregation for resistance to eastern hessian fly in the cross Pawnee X selection 52400 fit a 1:2:1 ratio. Selection 52400 possessed a partially dominant factor derived

from PI 119344-7 for resistance to western and eastern hessian fly. Field tests conducted at Columbia, Missouri upon F_4 lines of these two crosses gave close agreement with the greenhouse results.

Greenhouse studies indicated that Pawnee may possess two recessive factors that govern resistance to western hessian fly.

The inheritance of leaf rust was studied for three crosses in the F_4 generation. Results showed that Pawnee possessed a partially dominant factor that governed resistance to race 9 and 11 of leaf rust. Selection 52400 possessed a partially dominant factor, presumably derived from Hard Federation, for resistance to race 5, 9 and 15. This factor was linked with the partially dominant factor for hessian fly resistance carried by selection 52400. Apparently three factors governed resistance to race 9 in the cross Pawnee X selection 52400. Pawnee possessed one factor, selection 52400 possessed two. One factor possessed by selection 52400 suppressed the resistance of the Pawnee factor. The other factor possessed by selection 52400 was a partially dominant factor for resistance to leaf rust and located on chromosome XIV.

The reaction of ten sources of hessian fly resistance being utilized in the Kansas wheat breeding program was studied in crosses with known sources of hessian fly resistance. The selections IVc1-Comanche X Pawnee-Comanche, selection 472941; Pawnee X PI 94547-1, selection 52382; Pawnee X PI 119358, selection 52381; Chiefkan-Hard Federation-Kawvale X PI 119344-7, selection 52400; Pawnee X PI 119344-7, selection 52391; Mediterranean-Hope-Pawnee X Oro-Illinois No. 1-Comanche, CI 12804 were found to possess the same factor or an allele of the H_3, Illinois No. 1 factor. The same selections appeared to possess the h_4 factor. Apparently the H_3 and h_4 factor described in California are the same, alleles or pseudo-alleles as studied with midwestern hessian flies.

Pawnee-Ribeiro, selection 52357, possessed the H_5 factor of Ribeiro, PI 56206-8-1. In addition, selection 52357 apparently possessed a minor factor or factors for resistance derived from Pawnee.

Pawnee-PI 94587, CI 12855, possessed a single partially dominant factor (Hf_6), different from any heretofore reported. Crosses involving the durum parent, PI 94587, with H_3 and H_5 selections suggested that one major factor and possibly a minor factor or factors controlled resistance to western hessian fly in the durum PI 94587. A recessive factor governing resistance to race 15 of leaf rust possessed by Pawnee-PI 94587, CI 12855, was inherited independent of the Hf_6 factor.

Studies with Ponca indicated that possibly three different genetic factors governed resistance to western hessian fly. Resistance behaved recessively. One major factor and two minor factors appeared to be involved.

These studies indicated that at least six different factors for hessian fly resistance are being utilized in the Kansas wheat improvement program. 123 pages. $2.00.

THE INFLUENCE OF VARIOUS NITROGEN CARRIERS ON THE AVAILABILITY OF FERTILIZER PHOSPHORUS BY PLANTS

(L. C. Card No. Mic 58-1111)

Nai Lin Chin, Ph.D.
University of Minnesota, 1957

It had been observed in 1951 that nitrogen in the form of NH_4NO_3 applied together with ordinary superphosphate in the hill to corn had caused a large increase in the absorption of phosphorus. The phenomenon was of sufficient interest to warrant further investigation, and this study reports the results of field and greenhouse experiments on the influence of various nitrogen carriers on the absorption of fertilizer phosphorus by plants.

In the field experiments, the effect of nitrogen on phosphorus absorption was observed by applying in the hill to corn such nitrogen-phosphorus combinations as ammoniated superphosphates, monoammonium phosphate, and various rates and mixtures of nitrogen-bearing and phosphorus-bearing salts. Phosphate sources were labelled and absorption of phosphorus was determined by measuring the uptake of P^{32}.

It was found that in general NH_4^+ in the carriers such as $(NH_4)_2SO_4$, NH_4Cl and NH_4OH were more effective in the enhancement of phosphorus absorption by plants than NO_3^- in carriers such as $Ca(NO_3)_2$, $NaNO_3$ and HNO_3. The effect of NH_4NO_3 fell in between the above two groups. The absorption of phosphorus by plants from monoammonium phosphate was much higher than from monosodium or monocalcium phosphate. In fact the absorption of phosphorus from monoammonium phosphate was about the same as from monocalcium phosphate and NH_4^+ salt mixtures. It was also found that plants absorbed more phosphorus from ammoniated than nonammoniated superphosphates.

Data showed that nitrogen in the form of NH_4NO_3 increased phosphorus uptake by plants only from highly water soluble phosphates such as ordinary and concentrated superphosphates. NH_4NO_3 did not affect the phosphorus absorption by plants from low water solubility phosphates such as di- and tricalcium phosphates and metaphosphate.

It was found that the effects of nitrogen as NH_4NO_3 on phosphorus absorption from superphosphate in corn increased in effectiveness until the ratio of N to P_2O_5 became 1:4, after which the absorption became rather uniform.

Studies on water solubility in the laboratory showed that with a N to P_2O_5 ratio of 1:1, $(NH_4)_2SO_4$, $NaNO_3$, NH_4NO_3, and $(NH_2)_2CO$ did not affect the water solubility of phosphates of low and high water solubility.

Field observation failed to show any apparent visual difference in root development due to various nitrogen-phosphorus fertilizer placements.

Nitrogen-phosphorus combinations differed little among themselves in affecting corn yields, but as a whole gave superior yields to phosphorus alone. Sometimes the phosphorus content of corn was affected by nitrogen-phosphorus fertilizers and sometimes not.

In the greenhouse experiment, the effect of nitrogen on phosphorus absorption was studied by measuring the yield of phosphorus and the absorption of P^{32} by barley. Nitrogen carriers and concentrated superphosphate were

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intimately mixed with each of two soil types at various intervals of time before planting and at planting time. Labelled concentrated superphosphate used as a tracer was applied to all the pots at planting time.

It was found that all nitrogen sources increased both the phosphorus content and yield of barley, and the yield of phosphorus. This was contrary to what was found in field experiments where only NH_4^+ was effective in increasing phosphorus absorption by plants. When the yield of P^{31} and P^{32} were separated, it was noted that barley from $(NH_4)_2SO_4$ pots yielded the highest P^{32} and the lowest P^{31} Just the opposite was observed with the $NaNO_3$ pots.

The absorption of phosphorus from labelled material by barley was different on the two soil types used in the greenhouse experiment. Application of nitrogen-phosphorus fertilizers to the Waukegan soil prior to planting had little effect on uptake of phosphorus from labelled concentrated superphosphate. On the Barnes soil the absorption of phosphorus from the labelled source was generally increased by the presence of the other fertilizer materials, markedly so when they were applied at planting time.

104 pages. $2.00.

RELATION OF TIME OF YEAR AND SHORT PHOTOPERIOD TO FLORAL INITIATION AND DEVELOPMENT IN GARDENIA GRANDIFLORA

(Publication No. 25,482)

Walter Emanuel Davis, Ph.D.
The Ohio State University, 1952

Gardenia grandiflora is the species of gardenia that is grown for greenhouse forcing. It is especially useful as a tailored corsage flower and is also valuable as an ornamental shrub.

Considerable glass area is used for forcing of gardenia in the United States. However, the short season of heavy production during the spring and the lack of sufficient information on the requirements for successful forcing during other seasons have limited the availability and use of this flower. Fundamental information is needed concerning the growth of the gardenia to form a basis for developing methods of extending the production.

This investigation involves a study on the time of year that floral initiation occurs under greenhouse conditions, the effect of a short photoperiod on floral initiation, and the period of time required for the bud to reach anthesis.

Data in the literature regarding the effect of photoperiod on gardenia floral initiation and development are not in agreement. Prior investigations at The Ohio State University indicated that the gardenia was a short-day plant and that exposing the plant to short photoperiod during July 23 to August 13 increased flower production during the following Christmas period. Investigations at Cornell University reported that floral initiation occurred with any length of day and that flower buds failed to develop during short-days.

Procedure

The variety Hadley was used in these studies. The plants grew in gravel culture and at temperatures of 60° to 62° F. during nights, 65° to 67° during cloudy days and 70° to 72° F. during sunny days except when outside temperatures exceeded these ranges. For a period of one year, stem tips were tagged and similar tips collected for microscopical studies to discover when floral initiation occurred. Data on the time of flowering of the tagged stem tips was recorded to discover the period of time required for the floral buds to reach anthesis.

Tests were made to discover the effect of short photoperiod on floral initiation by exposing a group of plants to 9-hour days during the period from July 23 to August 13 and by exposing another group to the natural day-length during the same period. Stem tips were tagged on these plants and similar stem tips collected for microscopical studies. Data were recorded on the number of stem tips that produced flowers and on the time of floral initiation.

Results and Discussion

A description of the stem apexes in the vegetative and reproductive phases of growth was given in the dissertation, and photographs of longitudinal sections of the stem apexes were shown. The flower buds of Gardenia grandiflora were found to be terminal buds. Lateral buds originated in the axils of the leaves and within a sheath enclosure. When apical dominance was destroyed by the formation of a flower bud, differentiation occurred in the lateral bud thus producing a shoot. If conditions were favorable for floral initiation the lateral shoot was also terminated with a flower bud.

The bud sheath was initiated in the base of the leaf primordium. The sheath appeared as a protuberance at this point. With further development of the sheath the apical meristem became completely enclosed.

It can be concluded from this investigation that the gardenia is a short-day plant. Floral initiation occurred as a result of the plants being exposed to a short photoperiod. When the plants were exposed to long photoperiods and when the average night temperatures were above 70° F., floral initiation did not occur.

The time when conditions were found to be most favorable for floral initiation was during fall, winter, and early spring. These were months when photoperiods were short and the average night temperatures did not exceed 68° F. This further substantiates the fact that the gardenia is a short-day plant. The time when conditions were less favorable for floral initiation was during spring and summer when the photoperiod was long and the temperature did not drop below 70° F. There was a decided increase in the percentage of stem tips that formed flower buds when plants were exposed to a short photoperiod from July 23 to August 13.

It was observed that the rate of flower development was the slowest during fall, winter and early spring when the light intensity is known to be much lower than that required for optimum growth of most plants. This could be one of the factors involved in the slower rate of development observed during this period. The faster rate of development was observed during spring and summer when the light intensity was nearer optimum.

A practical significance of this investigation is that it is possible to bring about floral initiation by exposing the gardenia plant to short photoperiod. If the plant was exposed to short photoperiods during the period from July 23

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to August 13 the flower reached anthesis during the Christmas period when the prices of the gardenia are highest.
49 pages. $2.00. Mic 58-4778

Abstract published by special arrangement with The Ohio State University.

GENETIC VARIATION AND VARIABILITY OF FUSARIUM SOLANI F. PISI AND F. OXYSPORUM F. PISI RACE 2

(L. C. Card No. Mic 58-1118)

Robert Claire Hildreth, Ph.D.
University of Minnesota, 1957

Adviser: Thomas H. King

Fusarium root-rot of peas caused by Fusarium solani f. pisi (Jones) Snyder and Hansen, and Fusarium near-wilt of peas caused by F. oxysporum f. pisi (Sny) race 2 Snyder and Hansen, are considered major diseases of peas Pisum sativum L. Several methods have been used in attempts to control these two diseases by cultural methods, but resistant varieties appear to be the only practical control. However, progress in obtaining resistant commercial varieties has been very slow. One reason for this slow progress is associated with the variation and variability to be found in these two Fusarium species. The ability of F. solani f. pisi and F. oxysporum f. pisi race 2 to give rise to innumerable races or biotypes of varying pathogenic virulence makes breeding for resistance to root-rot or near-wilt an extremely difficult task.

A comparative study was made of the similarities of some of the cultural characters and cultural variability, and the similarities or differences in the development of pathogenic symptoms caused by isolates of F. solani f. pisi and F. oxysporum f. pisi race 2.

Thirteen monoconidial isolates of Fusarium solani f. pisi were selected from 150 mass cultures obtained from root-rot infected pea plants from various localities in Minnesota. These 13 isolates were compared with 4 monoconidial isolates of F. oxysporum f. pisi race 2 from Wisconsin for their similarities in cultural characters and pathogenic symptoms.

Single spore isolates of these two Fusarium species have a rather extensive range of cultural variability and genetic variation. This variation often results in considerable overlapping of many of the cultural characteristics of the two species. On the basis of growth rate, cultural phenotype, pigmentation and relative amount and kind of sporulation, as influenced by culture medium, temperature, light, and pH of the substrate, it would be difficult if not impossible to distinguish between certain isolates of F. solani f. pisi and certain isolates of F. oxysporum f. pisi race 2.

Pathogenicity studies revealed close similarities in virulence and symptom development. Fusarium solani f. pisi is capable of producing vascular symptoms identical with those produced by F. oxysporum f. pisi race 2. The fact that F. solani f. pisi invaded the upper stem of the pea plant far beyond its normal limitation of the region of the hypocotylcotyledon union is taken as evidence for its pathogenic similarity to near-wilt. Vascular penetration was heretofore considered to be a diagnostic character for near-wilt. Conversely, F. oxysporum f. pisi race 2 is capable of producing root-rot symptoms identical with those produced by F. solani f. pisi on the pea varieties Perfected Wales and New Era when grown in the greenhouse. Throughout the course of this study it was observed that certain isolates of F. oxysporum f. pisi race 2 caused severe cortical decay of the roots. This character has been used to diagnose Fusarium root-rot but rarely if ever occurs on plants infected by the near-wilt Fusarium.

As a result of these investigations it is hoped that new and more accurate methods of developing root-rot and near-wilt resistant pea varieties will be developed. Pathogenic symptoms, as previously described in the literature, or even very limited cultural techniques, are apparently of very limited use for separating these two pathogens.
79 pages. $2.00.

A STUDY OF THE GENUS TAXUS

(L. C. Card No. Mic 58-585)

Ray Albert Keen, Ph.D.
The Ohio State University, 1956

Adviser: L. C. Chadwick

The genus Taxus is represented in America by four indigenous species: T. canadensis Marsh, T. floridana Chap., T. globosa Schlect., and T. brevifolia Nutt. Cultivated species include: T. baccata L. from Europe, T. chinensis Rehd. from China, T. cuspidata Sieb. and Zucc. from Japan, the hybrid species T. media Rehder and T. hunnewelliana Rehder, and about one hundred cultivated varieties (cultivars) and clons. Only a few of the cultivars and clons offered in the nursery trade have official recognition or description. The naming of cultivars and clons in America has been generally relegated to horticulture by plant taxonomists. Taxonomy of the yews has been neglected by horticulturists generally. The confusion of names is a distinct handicap to the nursery trade.

The present study is the second in a series based on the Living Herbarium of Taxus at the Ohio Agricultural Experiment Station, Wooster, Ohio. However, the present study has been extended to include several arboretums and herbarium collections in the eastern United States. Many large specimen trees were located and measured. Only those plants actually observed and photographed are described in the study.

A cytogenetic study of the chromosomes of Taxus for possible taxonomic use gave negative results. Diploid somatic chromosomes from root tips were unsuitable for study. Haploid somatic chromosomes, from female gametophytes in early July, made excellent aceto-carmine smears. Meiosis occurs in the pollen mother cells in late September and early October at Wooster, Ohio. Only one type of material was available from most plants; however, the monoecious T. canadensis furnished both types of material, as did a few intersexual plants of other species. The haploid number of chromosomes in Taxus is twelve, with very minor differences in the number of chiasmata between species.

This study assigns only "fancy" names to the cultivars and clons, in accordance with the International Code of Nomenclature for Cultivated Plants; however, Latinized trinomials are retained as synonyms.

The following species, cultivars and clons, are described:

Taxus baccata L. ENGLISH YEW

Broom, Cheshunt, Compact, Dovaston, Glaucous, Golden, Golden Irish, Graceful, Heath, Irish, Michell, Overeynder, Roundtop, Shortleaf, Spreading, Variegated, Washington, Yellow Broom, Yellow Dovaston

Taxus brevifolia Nutt. PACIFIC YEW

Taxus canadensis Marsh. CANADA YEW

Dwarf Hedge

Taxus chinensis Rehd. CHINESE YEW

Taxus cuspidata Sieb. and Zucc. JAPANESE YEW

Adams, Bobbink, Cushion, Dwarf, Blue, Goldtip, Hiti, Intermediate, Prostrate, Pygmy, Thayer

Taxus floridana Chap. FLORIDA YEW

Taxus hunnewelliana Rehd. HUNNEWELL YEW

Taxus media Rehd. ANGLOJAP YEW

Andorra, Black, Brown, Cole, Costich, Dutweiler, Hatfield, Henry, Hicks, Hill, Kelsey, Moon, Robust, Sebian, Stoveken, Totem, Vermeulen, Ward, Wellesley

The Living Herbarium of Taxus with 108 accessions is proposed as the basis for a national register of Taxus nomenclature. 212 pages. $2.75.

SODIUM 2,2-DICHLOROPROPIONATE AND SODIUM 2,2,3-TRICHLOROPROPIONATE ABSORPTION AND TRANSLOCATION IN CERTAIN VEGETABLE CROPS AND RESIDUAL ACTIVITY IN SOIL

(Publication No. 24,640)

Enos Roland Laning, Jr., Ph.D.
Oregon State College, 1957

Major Professor: S. B. Apple, Jr.

Sodium 2,2-dichloropropionate (DPA) and sodium 2,2,3-trichloropropionate (TPA) were studied in regard to: (1) Absorption of sodium 2,2-dichloropropionate-2-C^{14} (DPA-2-C^{14}) and sodium 2,2,3-trichloropropionate-2-C^{14} (TPA-2-C^{14}) by the leaves of bean and sweet corn plants, and the translocation of C^{14} to other plant parts. (2) Absorption of DPA-2-C^{14} and TPA-2-C^{14} by the leaves of plants tolerant to the action of DPA (birdsfoot trefoil), and the translocation of C^{14} to other plant parts. (3) Residual activity of DPA and TPA as influenced by time and temperature in two soil types, and in sterilized soil.

The absorption and translocation of the radioactive chemicals were evaluated by radioautographs and by measurement of the radioactivity in various plant parts. The soil residual activity of DPA and TPA was measured by growth responses of sweet corn plants seeded after various intervals of soil storage at three temperatures.

The data indicate that as much DPA-2-C^{14} and TPA-2-C^{14} was absorbed by the plant leaves within two hours as in seven days, although both chemicals apparently were absorbed in greater quantity by the leaves of bean plants than sweet corn plants. Following the absorption of DPA-2-C^{14} and TPA-2-C^{14}, C^{14} was translocated from the treated area primarily toward the rapidly developing tissue which suggests that the C^{14} moved in conjunction with the photosynthates. The translocation of C^{14} was more rapid after treatment with DPA-2-C^{14} than TPA-2-C^{14}, but regardless of chemical treatment, translocation of C^{14} was more rapid in bean than in sweet corn plants.

Increasing the rate of application of DPA and TPA resulted in a decrease in the percentage of C^{14} translocated from the treated areas to other parts of bean or sweet corn plants. Treatment at different stages of growth, however, did not influence absorption and translocation.

Since DPA-2-C^{14} and TPA-2-C^{14} absorption and C^{14} translocation are similar in plants sensitive to, and tolerant to the action of DPA, it is proposed that absorption and translocation are not involved in the selective toxicity of DPA and TPA.

The growth responses of sweet corn indicated that TPA was inherently more toxic than DPA, and that under conditions favoring decomposition, TPA displayed long persistance in soil than DPA. Higher temperatures and possibly greater soil organic matter content increased the rate of detoxication of DPA and TPA in soil. Sterilizing the soil prior to treatment resulted in little or no chemical decomposition within the limits of this experiment.

155 pages. $2.05. Mic 58-4779

DIFFERENTIAL RESPONSE OF SEVERAL INBREDS AND SINGLE CROSSES OF CORN (ZEA MAYS) TO 2,4-DICHLOROPHENOXYACETIC ACID

(L. C. Card No. Mic 58-1132)

John Harold Miller, Ph.D.
University of Minnesota, 1957

Nineteen inbreds and eighteen single cross hybrids treated with zero, one-half, and one pound rates of 2,4-D at two different dates were studied under field conditions. The investigation was concerned with the effect of 2,4-D upon yield, growth, morphological development and stalk breakage of corn. Eight single cross hybrids were studied in detail relative to the intensity and duration of stalk brittleness following treatment with 2,4-D.

The yield of inbred lines, as a group, was reduced by 2,4-D proportional to the rate applied. Certain inbreds exhibited greater yield reductions when 2,4-D was applied at the 14 to 16-inch stage than at the 6 to 8-inch stage. The inbred lines varied in their resistance to stalk breakage and the development of abnormalities following 2,4-D treatment. The development of abnormalities was associated with yield reduction.

The yield of single cross hybrids was reduced by 2,4-D nearly proportional to the rate applied. Hybrids treated at the 8 to 10-inch stage generally produced less than when treated at the 18 to 20-inch stage. The single cross hybrids treated with 2,4-D varied in their resistance to stalk breakage. With certain hybrids, the population loss due to stalk breakage could conceivably account for a major portion of the yield reduction encountered with 2,4-D treatment. During the 6-week period following treatment with 2,4-D, these hybrids showed inhibition of growth. This was most marked during the first two weeks. Growth

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inhibition was more pronounced with the high rate and the late date of 2,4-D treatment. The individual hybrids varied in growth response to 2,4-D. At maturity, hybrids treated with 2,4-D were shorter than when untreated. The single cross hybrids varied markedly as to their morphological responses following 2,4-D treatment. These abnormalities of the leaves, roots and stalk were more pronounced following application of one pound of 2,4-D than one-half pound. They likewise were more pronounced in hybrids treated at the 8 to 10-inch stage than at the 18 to 20-inch stage. Morphological response of single cross hybrids treated with 2,4-D was associated with yield response.

Single cross hybrids varied both in the magnitude and the duration of stalk brittleness following treatment with 2,4-D. As the mean of the eight hybrids studied, stalk brittleness was most evident at one week after application, followed by a gradual decrease for a period of three to four weeks. The mean value for stalk brittleness at the close of the study indicated that the hybrids probably never fully recovered from this type of 2,4-D injury. One hybrid was of special interest in that maximum brittleness in the stalks did not develop until the third to fourth week following 2,4-D application. Stalk brittleness in the single cross hybrids was not strongly associated with the yield or the morphological responses of either the hybrids or of their parental inbred lines.

An association existed between parental inbred lines and single cross progeny for morphological responses and for yield reductions caused by 2,4-D. 107 pages. $2.00.

THE INFLUENCE OF ALFALFA GREEN MANURE ON THE AVAILABILITY OF PHOSPHORUS TO PLANTS

(Publication No. 25,461)

Kenneth Fred Nielsen, Ph.D.
The Ohio State University, 1952

The general trend of our fertilizing practices in the past century has been toward applying larger and larger quantities of elements to the soil. Benefits expected from large additions of fertilizers have often not been obtained. The soil is retaining considerable quantities of elements in a form very slowly available to plants. One of these elements required by plants for which this non-return is so noticeable is phosphorus. Seldom is more than 30% of the added phosphorus taken up by the absorbing mechanisms of the plant.

The work reported in the dissertation was undertaken to investigate the merits of fertilizing a meadow for corn. This practice consists of placing all or part of the fertilizer on the meadow that would ordinarily be applied to the soil at the time of planting the corn. The last cutting of this meadow would then be turned into the soil as a green manure. It was hoped that by following such a practice the phosphorus added would be more efficiently utilized.

Materials and methods

Soils used.-The soil samples used in the studies reported here were Wooster silt loam. These samples were taken from three adjacent plots which, due to past fertilization, represented three distinct levels of residual soil phosphorus. These soils are described briefly in Table 1.

Table 1. Soluble phosphorus, total phosphorus, organic matter content and pH values for the soil samples used.

	Soil 1	Soil 2	Soil 3
0.002 N H_2SO_4 soluble phosphorus in p.p.2m.	65.4	48.0	30.2
Total phosphorus p.p.2m.	600.0	480.0	456.0
Per Cent organic matter	2.7	2.4	2.2
pH	6.3	6.5	6.8

Laboratory methods.-A technique was developed for the quantitative measurement of radioactive phosphorus in solutions. Essentially the procedure consists of placing an aliquot of a digestion mixture containing the radioactive phosphorus in an aluminum cup and setting this cup in a lead chamber below the window of a mica window Geiger Meuller tube. The radiations emitted are then recorded by a scaling circuit connected to the tube. All plant samples were dried at 68° C. and ground for analysis.

The total phosphorus measurements were made according to an accepted procedure.

Greenhouse methods.-Four greenhouse experiments were conducted, three using the soils described in Table 1 and one using sand and exchange resins as a growth medium. The first two and the exchange resin experiments included corn as the test plant. The third experiment using soil was cropped with Sudan grass. A Neubauer experiment was also established in a constant temperature room.

The first two experiments were established as randomized block experiments with three replicates. The object for their establishment was to compare alfalfa to monopotassium phosphate as carriers of phosphorus. The main phosphate treatments are given in Table 2. There was a uniform treatment of 300 p.p.2m. nitrogen and 300 p.p.2m. potassium.

Table 2. Treatments for greenhouse corn experiment in 1951.

Treatment	Phosphorus added p.p.2m.			
	In alfalfa		As KH_2PO_4	
	Tagged	Non-tagged	Tagged	Non-tagged
1 Organic	75*	-	-	-
2 Inorganic	-	-	75	-
3 Organic combination	62.5**	-	-	12.5
4 Inorganic combination	-	62.5**	12.5	-
5 Check				

*Equivalent to 6 tons dry alfalfa per acre.
**Equivalent to 5 tons dry alfalfa per acre.

By use of the tracer technique it was possible to determine the amount of phosphorus in the corn plants, grown on the treated soils, from the added fertilizer.

The Neubauer experiment was established to study the

time factor in the release of phosphorus from alfalfa and monopotassium phosphate when added to the soil.

The sudan grass experiment was established to study the release of phosphorus from a soil due to the influence of organic matter. The main treatments are given in Table 3.

Table 3. Treatments for Sudan grass greenhouse experiment.

Treatment	Phosphorus added p.p.2m.			
	In alfalfa		As KH_2PO_4	
	Tagged	Non-tagged	Tagged	Non-tagged
1 Organic	40*	-	-	-
2 Inorganic	-	-	40	-
3 Organic combination	30**	-	-	10
4 Inorganic combination	-	8*	32	-
5 Check	-	-	-	-

*Equivalent to 9.38 tons of dry alfalfa per acre.
**Equivalent to 7.02 tons of dry alfalfa per acre.

The sand culture exchange resin experiment was established to study the release of phosphorus from some slightly soluble phosphates as influenced by decomposing alfalfa. The main phosphate treatments are given in Table 4.

Table 4. Treatments for sand culture exchange resin experiment.

	Phosphorus added p.p.2m. Phosphate carrier			
	$AlPO_4.4H_2O$	$FePO_4.4H_2O$	$Ca_3(PO_4)_2$	Rock phosphate
Alfalfa	75	75	75	75
No alfalfa	75	75	75	75

The exchange resins served the purpose of establishing 2 different pH levels in the experiment, one at 5.5 and the other at 7.3. The experimental design was a 4x2x2 complete factorial with 3 replications.

Results and discussion

Corn experiment using soil.–Height and dry weight data for corn in the greenhouse experiment are given in Table 5. All values given here are averages of three replicates.

The inorganic treatment consistently produced the greatest dry weight even when the plants were not as tall.

Data for total phosphorus over the checks and per cent phosphorus in the corn is given in Table 6.

The inorganic treatment yielded less total and per cent phosphorus than all the other treatments in which all or part of the phosphorus added was in alfalfa. Table 7 records the data for the per cent phosphorus in the corn from the tagged portion of the fertilizer.

When all of the phosphorus was added in a soluble inorganic carrier a greater per cent of that in the corn was from this carrier. However, the total phosphorus in these plants, as well as the per cent phosphorus, was lower than those where there was an addition of alfalfa. The differences in total phosphorus over the checks (Table 6) between the organic and inorganic treatments are related to the residual soil phosphorus levels. For soils 1, 2, and 3

Table 5. Heights and dry weights of corn in 1951 greenhouse experiment.*

Treatment	Soil 1		Soil 2		Soil 3	
	Height (cm.)	Weight (g.)	Height (cm.)	Weight (g.)	Height (cm.)	Weight (g.)
1 Organic	201	61.0	204	61.1	203	52.0
2 Inorganic	196	66.7	199	62.3	198	58.0
3 Organic combination	195	63.2	186	61.7	200	51.8
4 Inorganic combination	183	58.8	192	60.2	175	47.3
5 Check	165	44.1	148	23.5	109	12.0

*For height: Treatment L.S.D. (0.05) = 2.63
For weight: Soil L.S.D. (0.05) = 7.8
Treatment L.S.D. (0.05) = 4.6

Table 6. Total phosphorus over checks and percent phosphorus in corn from 1951 greenhouse experiment.*

Treatment	Soil 1		Soil 2		Soil 3	
	P over checks	Per cent P	P over checks	Per cent P	P over checks	Per cent P
	mg.		mg.		mg.	
1 Organic	38.6	0.125	36.8	0.100	27.5	0.074
2 Inorganic	15.6	0.080	20.7	0.073	25.8	0.065
3 Organic combination	33.9	0.114	37.5	0.101	27.6	0.075
4 Inorganic combination	31.4	0.118	31.6	0.094	20.6	0.068
5 Check	-	0.086	-	0.108	-	0.096

*For P over checks: Treatment L.S.D. (0.05) = 9.2
For per cent P: Soil L.S.D. (0.05) = 0.025
Treatment L.S.D. (0.05) = 0.032

Table 7. The per cent phosphorus in the corn plants from the tagged portion of the fertilizer in the 1951 greenhouse experiment.*

Treatment	Per cent phosphorus from tagged portion		
	Soil 1	Soil 2	Soil 3
1 Organic	23.6	25.7	54.6
2 Inorganic	37.6	39.6	62.9
3 Organic combination	27.6	29.7	50.8
4 Inorganic combination	8.5	9.0	20.8

*Soil L.S.D. (0.05) = 7.5.
Treatment L.S.D. (0.05) = 8.6.

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these differences are 23.0, 16.1, and 1.7 mg. of phosphorus respectively. These differences cannot be explained on the basis that the phosphorus in the alfalfa was more available to the plants than that in the monopotassium phosphate since the data in Table 7 show that the inorganic treatment gave the highest per cent phosphorus in the plants from the tagged fertilizer. These data indicate that the decomposition of alfalfa in the soils resulted in an increased availability of the residual soil phosphorus. This indication follows from three main considerations: (a) a lower availability of phosphorus in the alfalfa compared to phosphorus in the inorganic carrier, (b) the higher phosphorus content of corn growing on soil treated with alfalfa, and (c) a relationship of this higher absorption to the residual phosphorus levels of the soil.

Neubauer experiment. Data from the Neubauer experiment indicate that, under the conditions of the experiment, there was a maximum release of phosphorus from the treated systems during the period of 46 to 64 days after incubation started. Incubation was carried out at 71° F. ± 1° and the plants were grown under 400 ft. candle illumination.

Sudan grass experiment. Table 8 records data concerning per cent phosphorus in the Sudan grass from the tagged portion of the fertilizer.

Table 8. Per cent* phosphorus from the tagged portion of the fertilizer in the Sudan grass greenhouse experiment.

Cutting	Days	Treatment			
		Organic	Inorganic	Organic combination	Inorganic combination
1	42	1.71	1.63	0.52	0.28
2	70	5.53	1.91	4.20	0.74
3	98	21.40	3.45	24.40	2.17

*Actual values x 10^2.

These data show the phosphorus in the alfalfa becomes available to the plant. The amounts of tagged inorganic phosphorus added in the inorganic and inorganic combination treatments was approximately the same; to the combination treatment, however, was added the same amount of alfalfa (very low in phosphorus) as was added in the organic treatment. The results indicate there was a dilution of the inorganic phosphorus added in the combination treatment by phosphorus released from the soil samples by decomposition products of the organic matter.

Sand exchange resin experiment.–Total phosphorus data are recorded in Table 9.

The data show a very significant carrier difference and a pH difference. There was also a significant carrier-pH interaction as would be expected. There was not, however, a consistent nor a significant effect of the alfalfa treatment. In acid soils it is generally conceded that a large amount of the fixed phosphorus is in the form of iron and aluminum phosphates.

One would expect that if the decomposition products of organic matter release phosphorus from acid soils, a large part of it must come from the iron and aluminum phosphates. The results obtained in this experiment do not conform to the expectations. The explanation is not immediately apparent to the author.

Table 9. Total phosphorus in corn plants in sand culture greenhouse experiment.*

pH	Carrier							
	$AlPO_4.4H_2O$		$FePO_4.4H_2O$		$Ca_3(PO_4)_2$		Rock Phosphate	
	Alfalfa	No alfalfa	Alfalfa	No alfalfa	Alfalfa	No alfalfa	Alfalfa	No alfalfa
	mg.	mg.	mg.	mg.	mg.	mg.	mg.	mg.
5.5	50.00	52.83	29.00	33.46	87.22	81.71	7.05	7.28
7.3	20.29	22.13	11.70	13.17	34.40	33.61	8.25	6.60

*Carrier L.S.D. (0.05) = 8.82
pH L.S.D. (0.05) = 15.27

Summary

There is a definite release of phosphorus from a soil containing residual phosphorus when alfalfa green manure is allowed to decompose in it. The higher the soil residual, the greater the release. This release is probably brought about by many influences, of which anion replacement and local CO_2 acidification are of major importance.

There is a peak in the quantity of release of phosphorus from a soil into which a fertilizer application has been incorporated. According to the data presented here this peak should occur within a seven to fourteen week period after the incorporation.

The phosphorus combined organically in alfalfa tissue, upon incorporation into the soil does become available to plants.

The presence of organic matter reduces the contact of phosphorus contained therein with the fixing mechanisms of the soil.

One cannot compare alfalfa to monopotassium phosphate as a carrier of phosphate when both are added to a soil. The reason lies in the observation that organic matter itself, upon decomposition in the soil, brings about a release of phosphorus from the soil residual.

73 pages. $2.00. Mic 58-4780

Abstract published by special arrangement with The Ohio State University.

THE RELATIONSHIPS IN TWO BARLEY CROSSES BETWEEN F_2 PLANTS AND THEIR PROGENIES GROWN IN HILLS

(L. C. Card No. Mic 58-1141)

Alfred Eugene Slinkard, Ph.D.
University of Minnesota, 1957

Adviser: J. W. Lambert

The pedigree method is widely used in the development of self-pollinated small grain varieties. Its chief disadvantage is the land and labor required to grow and take care of a large number of selected plant progenies. This disadvantage might be overcome to some degree if the progenies of selected plants were planted in progeny hills

instead of the conventional short progeny rows. The objective of this study was to provide evidence on the expression of various plant and kernel characters in segregating, as well as non-segregating, populations of barley grown in hill plots.

Plant height, maturity date, 200-kernel weight, percent plump kernels, percent thin kernels, and yield were studied on 196 F_2 plants and their replicated hill progenies from each of two barley crosses. Frequency distributions, analyses of variance, heritability estimates, inter-generation correlation coefficients, and comparisons of the means were used to evaluate the variability and performance of the two crosses in hill plots.

There were no significant differences between the means of the two crosses for any of the characters studied in the F_2 or F_3. The symmetrical F_3 frequency distributions in both crosses for plant height and maturity date along with some evidence for transgressive variation indicate that these two characters may be conditioned by several factor pairs lacking dominance. The high mean yield of the F_3 populations in relation to their respective parents suggests an appreciable expression of heterosis. It appeared that small-seed size was dominant to large-seed size in both crosses and that a large F_3 population would be necessary to recover large-seeded segregates which were also desirable in other characters.

Heritabilities in the "broad sense" were highest for percent plump kernels and were successively lower for maturity date, percent thin kernels, 200-kernel weight, plant height, and yield. Percent plump kernels was considered the most sensitive measure of seed size.

The correlations between individual F_2 plants and their progenies grown in replicated hill plots were low. This may have been attributable partially to a heavy infection of Helminthosporium sativum in the F_2 generation.

Three experiments comparing data from hill plots with corresponding data from rod-row plots were grown in 1955 and 1956. Ten varieties and four rates of planting, i.e., 10, 20, 30, and 40 seeds per hill, were used in the 1955 experiments at Saint Paul and Rosemount, Minnesota. In general, there was a significant linear response to increased planting rate. The higher rates appeared to be preferable because of reduced within-plot variability.

The majority of the significant variety x rate of planting interactions were from Saint Paul where some bird damage occurred. Hill plots appear to be especially enticing to birds.

Differences between planting methods were significant for most characters in all three experiments. In general, the variety x planting method interactions were significant for most characters. However, the variances for this interaction were small in relation to corresponding variety and method variances; especially with respect to plant height and maturity. It was concluded that the hill method could be used effectively in F_3 or F_4 for evaluation of heading date, maturity date, plant height, 200-kernel weight, percent plump kernels, and percent thin kernels inasmuch as relatively high estimates of heritability were obtained for these characters and as reasonably high correlations were found between rod-row and hill data.

64 pages. $2.00.

THE EFFECT OF LIGHT INTENSITY ON THE INITIATION AND DEVELOPMENT OF FLOWER BUDS IN THE SAINTPAULIA

(Publication No. 25,422)

Richard Floyd Stinson, Ph.D.
The Ohio State University, 1952

Many amateur and professional growers experience occasional difficulty in attempting to bring about flowering in varieties of Saintpaulia ionantha. It was thought that the primary cause of this difficulty is insufficient light. However, it was not known whether the difficulty was due to failure of floral initiation or to arrested floral development. The purpose of the study was to determine the effect of various light intensity conditions upon floral initiation and development in this plant.

Plants of Saintpaulia ionantha variety Mentor Boy of a size having a partially developed first pair of leaves were used at the beginning of the experiment. These were grown in cloth-covered boxes in the greenhouse at the following foot candles of light: 100, 300, 500, 700, 900, 1100, and 1300. These light intensities represented the highest light intensities to which the plants were exposed in the course of a bright day. Optimum temperature, moisture, and nutrient levels for this plant were maintained. One leaf of each small plant was marked by means of a small colored rubber band hung on the leaf petiole. This identification was necessary so that leaf axils formed at about the same time could be examined in the course of the experiment. The inflorescence is axillary in Saintpaulia.

Preliminary sets of leaf axil samples were taken on September 13 and October 7, 1950. Thereafter, samples were taken every seven days until December 13th, when flower buds were discernable to the unaided eye.

These samples were cleaned and placed in a killing solution, exposed to a partial vacuum for one day, dehydrated, mounted in rubber paraffin, and cut into serial sections 8 microns in thickness by means of a rotary microtome. The sections were mounted on microscope slides and were stained by the Safranin-Analin Blue-Hematoxylin method.

Examination of the serial sections revealed an initiation and development pattern that could be divided into several stages.

The development of the axillary bud to form a rounded apex was designated "stage A." Stage B represented a bud in which two bract initials were distinguished. A bud having two meristematic zones at the apex, as well as two bracts, illustrated stage C. If these zones developed into pointed protuberances, they represented leaf primordia and the bud represented a vegetative shoot. If one zone gave rise to five protuberances, these were interpreted as sepals of the first flower of the cymose inflorescence of Saintpaulia. The appearance of these sepals indicated that floral initiation had taken place, and was designated as stage D. It was found that two bracts were often initiated by the second meristematic zone on the apex. Since each flower cluster in the cyme is subtended by a pair of bracts, this was interpreted as an indication of further branching of the inflorescence (stage E). Two more meristematic zones also often develop in succession on the apex. One usually becomes a floral apex, and often the other bears a pair of bracts and forms a second branch of the inflorescence.

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The inflorescence of a Saintpaulia usually consists of clusters of flowers and branches, each subtended by a pair of bracts. The flowers in each cluster are initiated in succession, as also are the branches of the inflorescence. Examination of inflorescences of this plant at anthesis revealed that each flower develops to anthesis in the same order in which it was initiated.

Under the light intensity treatments, it was found that no samples from the 100 f.c. plot had formed bracts until eleven weeks after treatment began. In samples from the 300 f.c. plot, bract initials were found eight weeks after treatment started. Sepal formation was not found in samples from the 100 f.c. or 300 f.c. plots in the course of the experiment, but was found in the 500, 700, 900, 1100, and 1300 f.c. plots nine or ten weeks from the beginning of treatment. The formation of a second pair of bracts was found in the ninth or tenth week in all except the 100 and 300 f.c. treatments.

Vegetative growth in the 700, 900, 1100 and 1300 f.c. plots was very similar in appearance. Plants from the 500 f.c. plot appeared less vigorous than the plants in the above plots did, and plants from the 300 and 100 f.c. plots had increased in size only slightly in the course of the experiment.

It could not be stated with certainty whether a broadening of the apex preceded a change from a vegetative to a reproductive type of growth in Saintpaulia as has been found for many other angiosperms. The first indication that floral initiation had taken place was the appearance of the sepal primordia of the first flower of the inflorescence.

The floral organs were found to be initiated in acropetal succession, that is, sepals first, followed in order by petals, stamens, and pistils, which conforms to the pattern found for many other angiosperms.

The fact that floral initials and evidence of inflorescence branching were evident only in samples from plots having light intensities of 500 f.c. or higher indicates that low light intensities have an inhibiting effect upon floral initiation in this plant. This suggests that reduced photosynthetic activity is the cause of failure of floral initiation in Saintpaulia.

No instances of arrested development of the flowers were found in any samples, which seems to indicate that light conditions favorable for floral initiation in this plant are identical with those favorable to floral development.

It therefore appears that when other environmental conditions are favorable, the failure of this plant to flower is the result of insufficient light for initiation and development of flowers. 44 pages. $2.00. Mic 58-4781

Abstract published by special arrangement with The Ohio State University.

THE EFFECT OF DATE OF HARVEST, SUBSEQUENT METHODS OF PACKING, AND PERIODS OF STORAGE ON THE RATE OF RESPIRATION AND SOME OTHER MATURITY INDICES OF ROME BEAUTY APPLES

(Publication No. 25,450)

Sik-Vung Ting, Ph.D.
The Ohio State University, 1952

The Rome Beauty apple has proved to be a profitable variety in the Ohio apple industry. However, considerable losses are frequently sustained by the growers as well as by the retailers of Rome Beauties because of the appearance of scald after the fruits have been removed from cold storage. This disorder may be somewhat reduced by delayed picking and by the use of shredded oiled paper in the storage containers. The present study was undertaken to determine the changes of respiratory activities and some other characteristics of the Rome Beauty during the maturing season and the effect of the methods used for scald control on these changes in fruits after various periods of time in storage.

At time of harvest — The data from fruits taken from the three orchards in the 1949-1950 season and from two orchards in the 1950-1951 season indicated that as the fruits developed on the tree during the period between 140 days (first picking) and 175 days after full bloom (last picking), there was in general a slow increase in the respiration rate, an increase in ground color values, reducing sugars, and non-reducing sugars, and a decrease in total acidity, alcohol insoluble solids, and firmness of the fruits. The results on the pH measurements of the fruits were erratic (Table I). The data also show that all these changes in the maturity indices were relatively slow.

Table I. The rate of respiration (mg. CO_2/kg./hr.) and some other maturity indices of Rome Beauty apples during the maturing period.

1950-1951 season - Belmont County

Date of picking	Respiration rate (mg. CO_2/kg./hr.)	Ground color	Firmness*	Total sugars	Reducing sugars	Non-reducing sugars	Alcohol insoluble solids	Total acidity	pH	Sugar acid ratio
Oct. 3	14.8	1.2	20.7	7.93	5.87	1.96	3.88	.63	3.48	12.6
Oct. 10	17.3	1.4	20.2	7.45	5.33	2.11	4.77	.66	3.40	11.3
Oct. 17	17.4	1.5	20.0	7.95	6.05	1.80	3.86	.54	3.60	14.7
Oct. 24	21.1	2.0	17.6	8.06	5.76	2.19	4.07	.55	3.30	14.7
Oct. 31	20.8	2.0	17.4	8.55	6.52	1.93	2.59	.50	3.39	17.1
Nov. 7	24.3	2.1	16.4	10.47	7.55	2.77	2.05	.44	3.55	23.8

*From 1949-1950 season data.

Changes in maturity indices of fruits at 70° F. immediately after harvest — Figures 1 and 2 show the changes of the maturity indices from time of harvest to the end of four weeks at 70° F. The rate of these changes was noted to be significantly greater than that which occurred when the fruits were still on the tree. The rate of respiration of all samples reached a climacteric maximum after various numbers of days. The later the picking, the fewer days were required to reach the climacteric peak. When the fruits reached their climacteric maximum, the ground color and the total acidity of these fruits were in a definite range (Table II).

Data set forth in Figures 1 and 2 show that the reducing sugars of the early picked fruits increased slowly for the first two weeks but rose quickly during the next two weeks. In the case of the late picked fruits the increase

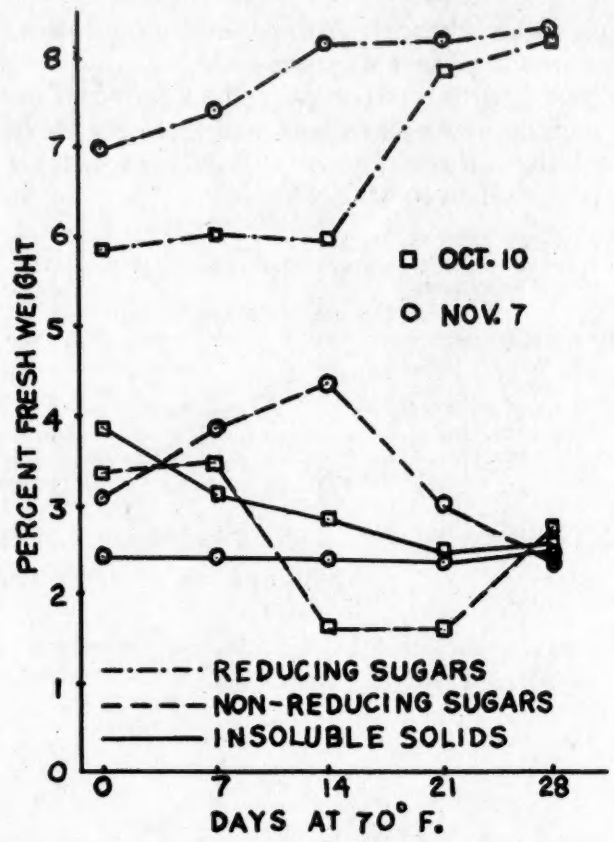


Figure 1. The changes in concentrations at 70° F. of reducing sugars, non-reducing sugars and alcohol insoluble solids of Rome Beauty apples. (Wayne County.)

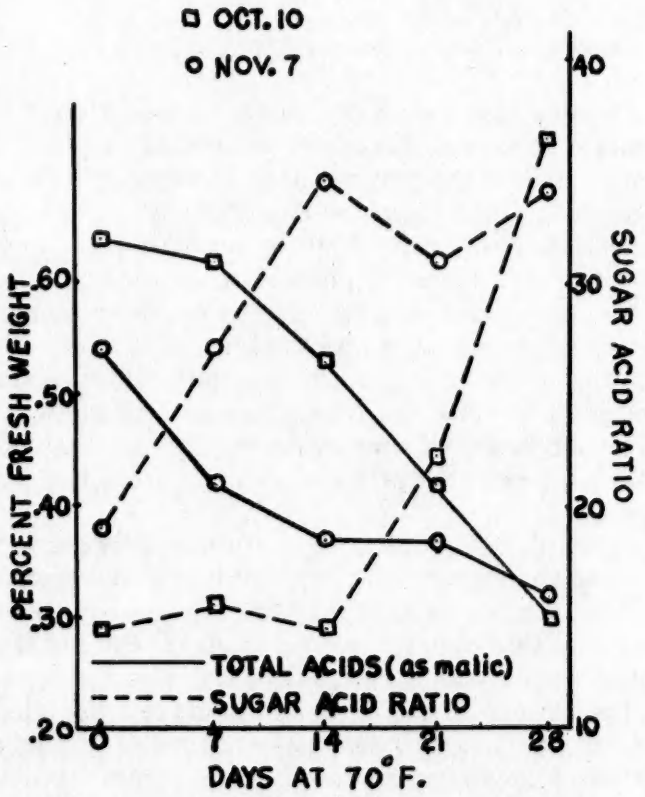


Figure 2. The changes in magnitude at 70° F. of total acids (as percent malic acid of fresh weight) and the sugar acid ratio of Rome Beauty apples. (Wayne County.)

was fast at first and became more gradual (only the first and last pickings are shown since the others were intermediate to the two extremes). The non-reducing sugars of the early picked fruits, however, decreased at first and increased thereafter, while those of the late picked fruits had

Table II. The number of days required to reach the climacteric maximum and the ground color values and total acids at the climacteric of Rome Beauty apples. 1950-51 season - Wayne County

Date of picking	Days required to reach the climacteric peak	Ground color values	Total acids (per cent malic acid of fresh wt.)
October 3	17	1.4	.53
October 10	17	1.7	.51
October 17	10	1.7	.50
October 24	6	2.0	.51
October 31	6	2.2	.45
November 7	3	2.1	.46

a reversed trend, i.e., increased at first and then decreased. The alcohol insoluble solids of the early picked fruits were much higher than the late picked ones, but the former showed a consistent decrease while the latter remained relatively unchanged. Regardless of the concentration of the total titratable acid at the time of harvest, fruits of both early and late pickings had similar concentration after four weeks at this temperature. The pH showed in general a slight increase in all pickings. The sugar acid ratio of the fruits showed a continuous increase in all pickings, but the ratio was much higher and the rate of increase greater in the later pickings than in the early pickings.

The changes of maturity indices during storage — In all samples studied, the respiratory activity of fruits increased as the fruits were stored longer (Table III). The

Table III. The effect of duration in storage on the respiratory activity of Rome Beauty apples (Grams CO_2/kg./14 days). 1949-1950 season - Belmont County

Date of picking	Removed from storage (Grams CO_2/kg./14 days)		
	December	February	April
Sept. 20	5.90	9.48	10.61
Sept. 27	6.16	8.38	10.67
Oct. 4	5.99	6.84	7.81
Oct. 11	6.10	7.33	7.73
Oct. 18	5.65	5.95	7.44
Oct. 25	5.26	5.80	8.05

changes of other maturity indices of the fruits are shown in Figures 3 and 4. The early picked fruits had greater change during the early storage period (between the time of picking and the time the fruits were first removed from the storage). There was a decrease in firmness and acidity. But in both instances, the changes during the later storage periods were less. The changes in pH were insignificant. Fruits stored longer had more yellow ground color (higher ground color values). In the carbohydrate determinations reducing sugars were found to increase throughout the storage periods while sucrose showed a tendency to increase at first and then decrease. The alcohol insoluble solids of early pickings decreased between the time of picking and the time when the fruits were first removed from storage in January. During the three months between January and April, no significant decrease in the

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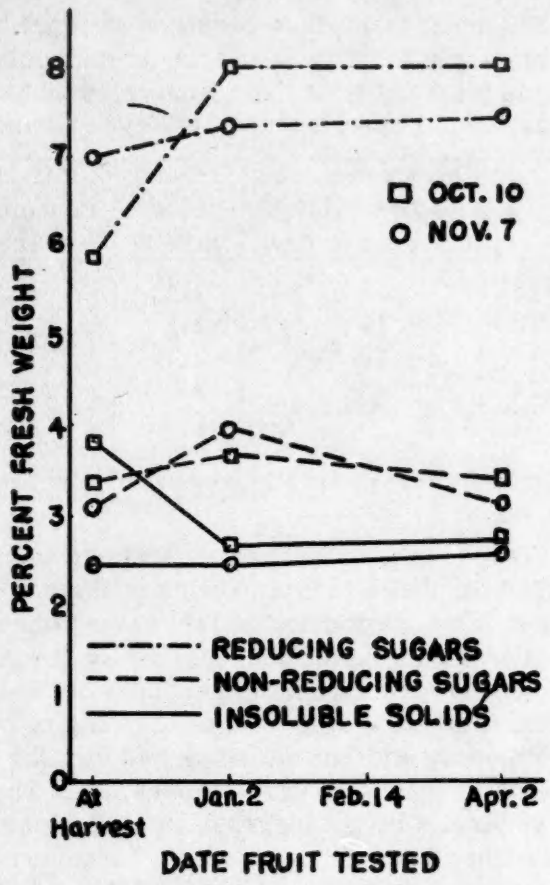


Figure 3. The changes in concentrations of reducing sugars, non-reducing sugars and alcohol insoluble solids of Rome Beauty apples after storage. (Wayne County.)

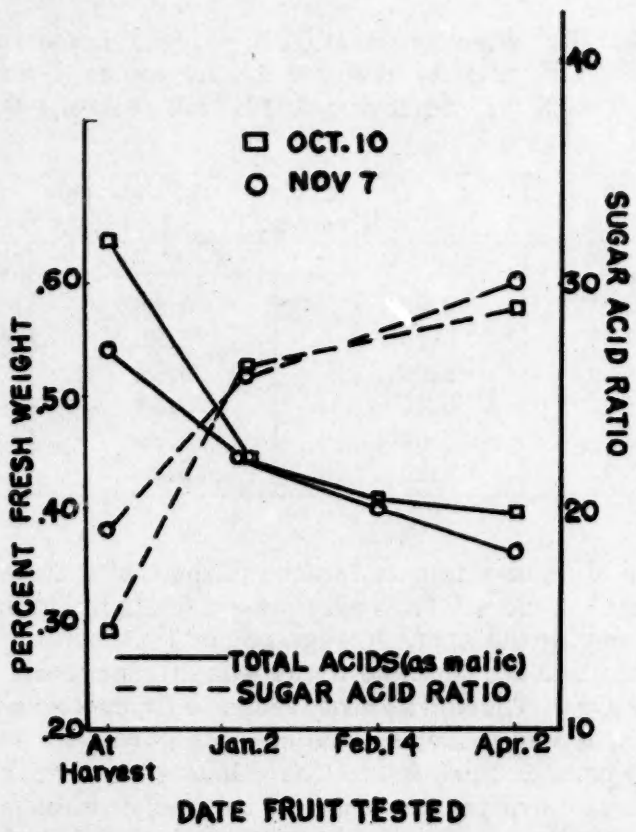


Figure 4. The changes in magnitude of total acids and the sugar acid ratio of Rome Beauty apples after storage. (Wayne County.)

alcohol insoluble solids was noted. In the later pickings, the alcohol insoluble solids did not decrease throughout the storage periods.

The effect of type of package — The effect of type of package on the changes of these maturity indices following storage was also investigated. The results are given in Table IV. In order to compare these effects, the averages of all picking dates were obtained from all storage periods. Although the differences were small, the dates were consistently obtained in all orchards.

Table IV. The effect of types of containers on the respiratory activity and some maturity indices of Rome Beauty apples.

1950-1951 season - Wayne County, Ohio

Type of containers	Respiratory activity Grams CO_2/kg./hr.	Firmness (pounds)	Ground color	Total acids per cent malic	pH	Reducing sugars	Non-reducing sugars	Total sugars	Alcohol insoluble solids	Sugar acid ratio
Baskets	8.82	13.0	1.7	.408	3.69	7.65	3.62	11.27	2.66	11.6
Baskets with oiled paper	8.34	12.7	1.8	.401	3.67	7.56	3.43	10.99	2.50	14.3
Crates	8.93	12.7	1.8	.403	3.68	7.64	3.37	11.01	2.60	13.8

180 pages. $2.35. Mic 58-4782

Abstract published by special arrangement with The Ohio State University.

A STUDY OF PENETRATION BY PUCCINIA GRAMINIS VAR. TRITICI

(L. C. Card No. Mic 58-1168)

Roy D. Wilcoxson, Ph.D.
University of Minnesota, 1957

Adviser: J. J. Christensen

Various factors: waxy bloom on wheat plant surfaces, stomatal behavior, illumination applied to plants in dew chambers, and the environment in which plants were placed after being taken from the dew chambers, were studied in connection with their effect on the ability of Puccinia graminis var. tritici to penetrate.

No correlation was found between waxy bloom and the amount of stem rust on peduncles and leaf sheaths of wheat varieties growing in the disease gardens at St. Paul, Minnesota in 1955 and 1956. Removal of the waxy bloom from 8 varieties of wheat growing in replicated field plots in 1955 did not change the amount of stem rust on those plants.

Stomatal behavior of 12 varieties of wheat growing in the field varied with variety, but day to day variability in the time at which stomata became half way open was so great that this characteristic of plants did not appear to be correlated with stem rust resistance during 1955.

The amount of stem rust on adult and seedling wheat plants from darkened dew chambers was just as great as that which appeared on comparable plants from illuminated dew chambers. Large and small quantities of inoculum were applied to seedling plants in darkened and illuminated (250 foot candles of light) dew chambers and though the number of penetrations varied with both the amount of inoculum applied and the variety of wheat tested, darkness did not reduce the number of penetrations by the stem rust fungus.

Stomata of adult and seedling wheat plants were open in darkness in large enough numbers to account for all penetrations observed on each variety tested. Stomata

were studied by using epidermal strips fixed in absolute ethyl alcohol. Checks on the technique for observing stomata indicated that stripping and fixing the epidermis did not cause the stomata to open.

The number of rust flecks of race 15B on seedlings of 3 wheats was significantly reduced by mercuric chloride applied to the plant surfaces after they came from the dew chambers indicating that the fungus normally may enter after plants are no longer in a saturated atmosphere.

The environmental conditions in which the plants were placed after they were taken from the dew chamber greatly influenced the ability of the stem rust fungus to penetrate. Substomatal vesicles of race 15B on Little Club wheat seedlings were observed by examining epidermal strips as soon as the plants were taken from the dew chamber and at intervals thereafter for several days. Occasionally a few substomatal vesicles formed on plants in the dew chamber, but they usually did not appear until approximately 8 hours after the plants had been removed from the moisture. Once the substomatal vesicles began to appear they continued to form for a period of several days. After plants had been taken from the dew chamber, holding them 8 hours at 65° F and 95 percent relative humidity before placing them in the greenhouse resulted in the formation of the greatest number of substomatal vesicles; an intermediate number of vesicles formed on plants held continuously in the greenhouse after the period in the dew chamber; and the least number of vesicles formed when plants were held 8 hours at 75° F and 50 percent relative humidity before being taken into the greenhouse.

87 pages. $2.00.

ANATOMY

THE EMBRYONIC ORIGIN OF THE DERMIS IN TARICHA TOROSA

(L. C. Card No. Mic 58-1298)

William Medina Neff, Ph.D.
Stanford University, 1958

The question of the embryonic origin of the dermis has long been a matter of controversy; yet no one, in recent years, has directly attacked the problem experimentally. The dermatome, lateral plate mesoderm, neural crest, and epidermis, which have been suggested as possible sources of the dermis, were studied experimentally to determine their contribution to dermis formation.

The method of approach was the application of microsurgery to embryonic areas of neurula and tailbud stages of the California newt, Taricha torosa. Small quantities of neural fold, neural crest, lateral plate mesoderm, and somite mesoderm were individually isolated in epidermal vesicles to test the dermis-producing potential of these tissues. The role of the neural crest in dermis formation was studied by extirpation and transplantation experiments, while vitally stained neural crest cells were used to demonstrate possible fibroblasts in the dermal region.

It was found that all the tissues tested, with the exception of epidermis, were capable of forming dermal connective tissue. However, neural crest cells in tailbud belly epidermis failed to form a dermis, indicating the existence of some interaction between the neural crest and ectoderm. The transplantation studies tended to confirm this possibility, while the extirpation series demonstrated that other tissues compensated for deleted neural crest cells in dermis formation. These results indicated that the dermatome and lateral plate were capable of forming a dermis, but that the neural crest could form a dermis only in the dorsal region. 53 pages. $2.00.

ANTHROPOLOGY

SUBSISTENCE AND SOCIAL STRUCTURE: AN ECOLOGICAL STUDY OF THE KUIKURU INDIANS

(L. C. Card No. Mic 58-891)

Robert Leonard Carneiro, Ph.D.
University of Michigan, 1957

This dissertation attempts to show in what ways ecological factors, especially the mode of subsistence, have influenced and molded the social organization of the Kuikuru, an Indian tribe of central Brazil. The premise underlying this study is that by and large, in any society, man-to-nature relationships determine man-to-man relationships. The body of the thesis is devoted to examining to what extent this has been true among the Kuikuru.

The Kuikuru live in a tropical forest, a type of environment with definite potentialities and limitations for a society which practices slash-and-burn horticulture, as they do. The aboriginal technology used by the Kuikuru in exploiting their habitat has been augmented by the adoption of Western tools and utensils. The interaction of technology and environment in the process of subsistence is studied, particularly as it occurs in the cultivation of manioc, the Kuikuru's staple crop.

The aspect of Kuikuru social organization dealt with first is the division of labor. An explanation is suggested

of why cultivation is carried on by the men instead of by the women, and it is indicated, furthermore, how this key role allocation has affected the rest of the sexual division of labor. The amount of craft specialization, which is moderate, is shown to be limited by the small size of the market for the products of specialists.

The rest of Kuikuru social life is studied in terms of levels of social organization. The lower levels comprise the nuclear family, the extended family, and the household. The higher levels include ceremonial teams, work parties, political authority, etc. An assessment is made of the ways in which these forms of Kuikuru social structure have been influenced by the mode of subsistence.

Consideration is next given to relations between the Kuikuru and other tribes of the region, especially in matters of intermarriage, trade, joint ceremonialism, and warfare. It is suggested that each village in the region has remained politically autonomous because of the low incidence of warfare, which has made military confederacies unnecessary.

Two conclusions reached in this study are: (1) the secure subsistence provided by the cultivation of manioc has left its impress on many aspects of Kuikuru social life, and (2) despite recent alterations in the material substratum of Kuikuru culture as a result of borrowing, a high degree of integration still exists between techno-economic factors and features of social organization.

An attempt has been made, where possible, to point out the general implications of certain aspects of Kuikuru culture. For example, Kuikuru data shed light on such diverse problems as the origin of local exogamy in human society, and the possibility of village permanence under slash-and-burn agriculture. 349 pages. $4.50.

THE DEVELOPMENT OF PATTERNS OF KINSHIP NOMENCLATURE

(L. C. Card No. Mic 58-902)

Gertrude Evelyn Dole, Ph.D.
University of Michigan, 1957

The purpose of this thesis is to present a theory of systematic development of kinship nomenclature and to indicate the factors which appear to be most effective in determining each of various representative patterns of nomenclature. The theoretical construct presented here is based on a study of more than 450 kinship nomenclatures, together with the kinship practices which are associated with a large number of the nomenclatures.

In Part One is outlined the development of kinship structure, that is, the factors of social organization which establish the alignment and customs of interpersonal behavior of individuals who are regarded as relatives. Special attention has been given to the following factors: 1) the size and composition of local groups and 2) the distance between adjacent local groups; 3) patterns of residence; 4) types of exogamous units and 5) customs of preferential marriage; 6) types of kin groups; and 7) modes of inheritance. The types of kinship structure outlined here represent successive steps in a developmental sequence and are exemplified by the Andamanese, the Dakotans, Rewa Fijians, Cherokee, Arabs, and industrial Americans respectively.

In Part Two is presented a typology of nomenclature patterns. Kinship nomenclatures representing all major ethnographic areas of the world and all general types of cultures are classified according to nine representative types. In order to relate these patterns of nomenclature to the development of kinship structure, the social organization associated with each type of nomenclature has been analyzed with particular reference to the seven factors of kinship structure described in Part One.

Patterns of kinship nomenclature were found to be correlated in a general way with the development of subsistence techniques and with levels of complexity in social organization. Thus classificatory nomenclatures, in which some collateral relatives are merged with lineal, are correlated with primitive society. This correlation reflects the existence of strong bonds of dependence and obligations which link members of the extended family in primitive society. By contrast, in civil society the nuclear family is independent of the kindred. Correspondingly descriptive nomenclatures, in which lineal relatives are designated by terms different from all collateral relatives, are found only in societies which are associated with civilization. In addition to these gross correlations it was found that each of six patterns of nomenclature is correlated with a separate type of kinship structure as described in Part One. Three other patterns of kinship nomenclature appear to be the result of varying degrees of disturbance of the social alignment and customs of interpersonal behavior between relatives.

The principal differences between the typology presented here and those proposed by most other students of kinship result from the use of a developmental approach. This approach has been used in order to single out the elements of social organization which produce differences in the nomenclature patterns of various types of cultures. Of the seven factors of kinship structure investigated, customs of residence, marriage, and inheritance were found to be the immediate determinants of nomenclature pattern. The various types of kin groups and rules of descent are formed by the same elements of kinship behavior as are the nomenclature patterns. It was concluded, therefore, that kin groups and descent influence the nomenclature only through the associated customs of residence, marriage, and inheritance. 477 pages. $6.10.

THE PONCA TRIBE

(L. C. Card No. Mic 58-931)

James Henri Howard, Ph.D.
University of Michigan, 1957

Although the Ponca tribe of American Indians has been in contact with White civilization for over 150 years, no comprehensive ethnography of this tribe has been written. The published materials concerning the Ponca are diffuse and of uneven quality. Many of the tribal institutions have been neglected entirely, and other features of the culture have been treated in only a general manner. Consequently, it has been difficult even to assess the cultural position and affiliations of the tribe.

The first purpose of this study is to furnish a more adequate description of the aboriginal culture of the Ponca. Toward this end, the literature was surveyed and collated

and these results supplemented by fieldwork. Two months of field study with native informants was carried out among the Northern Ponca of Nebraska and South Dakota. Two and one-half months were spent similarly with the Southern Ponca of Oklahoma. The descriptive section (Chapters I through IX) is based on the integration of library and field studies.

Early in the study, important differences were noted between the Northern and Southern bands. As the bands were one until 1879, it is presumed that differentiation developed subsequent to their separation. The second objective was to demonstrate the band differences which exist and to suggest factors which were responsible for these divergencies. The differences are treated individually in the descriptive sections and the factors presumed responsible discussed in the final chapter.

The Southern Ponca, on the whole, seem to have had more resistance to the forces of White acculturation. Yet, in certain respects, the Northern Ponca were the more conservative. The earliest known Ponca culture seems to have been very close to that of the Central Algonquin and Southern Siouan tribes, which were adapted primarily to a woodland environment. After reaching the Niobrara region, the Ponca gradually assumed traits characteristic of the Plains tribes, at first borrowing most extensively from the Pawnee and Arikara, but later more heavily from the Teton and Yankton Dakota.

After the division of the tribe in 1879, influences of the Dakota neighbors on the Northern Ponca continued, but the Southern Ponca were in close contact instead with various tribes on reservations in Oklahoma. During the years, these distinct tribal influences resulted in differential modifications of the cultures of the two bands. Other operative factors were the disparity in size of the two bands, and the greater degree of intermarriage with Whites by the Northern band.

Still another factor has been the participation by the Southern Ponca in Oklahoma Pan-Indianism. The process of Pan-Indianism is that by which certain Indian groups are developing a non-tribal generalized "Indian" culture. In Oklahoma, its principal expressions are in the powwow, the Ghost Dance hand game, and the Peyote Cult. These are discussed in detail and the general trends of the movement are sketched. Among conditions which are considered to have fostered the growth of Pan-Indianism are ethnic discrimination, the common low economic level of most Indians, intermarriage between diverse tribes, increased geographic mobility, and school contacts.

Finally, an attempt is made to relate the Pan-Indian movement to general anthropological knowledge and theory. Pan-Indianism is represented as a revitalizing and unifying movement which provides the Indians with a fund of common knowledge and experience which sets them apart from other ethnic groups, maintains their dignity through intertribal solidarity, and permits accommodative adjustment to the dominant American culture. Although solidarity is now limited to the social and religious spheres, potential economic and political advantages inherent in larger size perhaps may be realized in the future. 316 pages. $4.05.

THE EXPLANATION OF THE DISTRIBUTION OF THE SICKLE CELL GENE IN WEST AFRICA WITH PARTICULAR REFERENCE TO LIBERIA

(L. C. Card No. Mic 58-1427)

Frank Brown Livingstone, Ph.D.
University of Michigan, 1957

According to modern genetic theory as developed by Wright and others, there are five factors which can contribute to gene frequency change. These are: mutation, selection, gene drift, gene flow, and selective mating. Recent attempts to explain the distribution of the sickle cell gene by just one of these factors have been unsuccessful. The purpose of this study is to attempt an explanation of the distribution of the sickle cell gene in West Africa by taking into consideration all of these five evolutionary factors.

First the data on the frequencies of the sickle cell trait of the native tribes of West Africa were presented. For the fifteen native tribes in Liberia these data were based on investigations by the author. For the rest of West Africa the tribal frequencies were based on both the published and unpublished results of other investigators.

After plotting the distribution of the sickle cell gene in West Africa, an attempt was then made to determine the effect of each of the five evolutionary factors on this distribution. From this analysis it was concluded that the two factors, selection and gene flow, played the major roles in determining the distribution of the sickle cell gene in West Africa. The evidence seemed to indicate that the heterozygote for the sickle cell gene possesses a relative immunity to falciparum malaria, and that, due to falciparum malaria, the female heterozygote has a greater fertility than the normal female. Thus, the high frequencies of the sickle cell gene are the result of a balanced polymorphism in which the selective advantage of the heterozygote offsets the selective disadvantage of the homozygote for the sickle cell gene.

Although the evidence indicates that the high frequencies of the sickle cell gene are due to falciparum malaria, there are many populations in West Africa in which falciparum malaria is holoendemic but which have low frequencies of the sickle cell gene. In one area of low frequencies, the Northern Gold Coast, the populations have high frequencies of the Hemoglobin C gene, an allele of the sickle cell gene. Since no data are available on the relative fitnesses of the six genotypes involved in this triallelic system, no attempt was made to explain the frequency of the sickle cell gene in this area. In the other two areas of low frequencies of the sickle cell gene in Portuguese Guinea and Eastern Liberia, the Hemoglobin C gene is rare or absent. Thus, these populations appear to be very far from equilibrium with respect to the sickle cell-Hemoglobin C locus. It was concluded that two factors accounted for this disequilibrium: (1) The populations with low frequencies are the remnants of previously more widespread hunting populations, who have been forced back into these areas by later migrants who introduced the sickle cell gene into this part of Africa. (2) The environmental conditions necessary to maintain holoendemic malaria are not characteristic of a mobile hunting population, so that holoendemic malaria has only recently spread to these populations when they adopted agriculture. Thus, the spread of the sickle cell gene is only now following the spread of the selective advantage of this gene. 163 pages. $2.15.

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TELL TOQAAN: A SYRIAN VILLAGE

(L. C. Card No. Mic 58-1469)

Louise Elizabeth Sweet, Ph.D.
University of Michigan, 1957

This dissertation is primarily a description of the people, language, history, and culture of the village of Tell Toqaan, Syria. The period of resident observation extended from January 4 to May 20, 1954.

The dissertation is introduced with a discussion of the socio-cultural situation in the Levant States of the Near East. This area is seen as a socio-cultural whole in which three socio-economic systems interrelate. The urban system, as the locus of political power, dominates the area. Through the contract and land tenure systems and commercial enterprise, it concentrates the agricultural and pastoral surplus production in the urban centers and marketing system. There is a marked urban-rural dichotomy. The rural area is further marked by the technological and economic dichotomy, and consequent socio-political dichotomy, between nomadic shepherd pastoralism and sedentary village agriculture.

Emphasis in the introduction is on the characteristics of the Levant village system as a peasant subculture and its relation to the shepherd pastoral and urban systems. The chief characteristics of the Levant village system are tentatively proposed. Major changes in the village system, particularly since the beginning of the mandate period, 1920, are reviewed. Finally, the Levant village system as a peasant society and subculture in a feudal society and culture are discussed. This introduction provides the contest for the description of Tell Toqaan as a Syrian village.

There follow, in chapters II to XIV, the descriptive materials on Tell Toqaan. The geography, history, physical appearance and condition of the people, and language are discussed. Tell Toqaan is a small village of 326 people located about 40 miles south southeast of Aleppo, Syria, at the foot of the Maadek marsh. It is about 90 years old. Sedentarized pastoralists and peasants of diverse origins compose its population. It is the headquarters of the sheikh of a small, partly settled shepherd tribe.

Tell Toqaan is heterogenous in cultural content and structure. The cultivation of traditional field crops and irrigated gardening are the basis of its economy, but to these are added flocks of sheep and goats which are of local importance. Cotton is becoming important as a cash crop. Tell Toqaan is mixed in technology. Both peasant and pastoral techniques are present. The use of industrial agricultural machinery illustrates one manner by which industrial civilization is spreading in the Levant area. Crafts and exploitation of natural resources for non-agricultural products have small importance in the village and are not marketed outside. Commercial relations between the families in the village predominate rather than traditional peasant village customs of mutual aid. Both peasant and wage labor types of economic organization are found. Part of the village society is composed of a core of long-resident peasant lineages, but a large proportion of the families are nuclear and neolocal. The villagers are Sunni Muslim, but three of the four schools of Islamic law and rite are represented.

The dissertation concludes with a discussion of Tell Toqaan as an atypical village because of its ethnic and cultural heterogeneity and the penetration of industrial agricultural tools and techniques. The major direction of change is toward increased control by the elite landlords over the means of production in land, technology, and economic organization at the village level. The ultimate consequence is destruction of traditional, small scale peasant village organization. 455 pages. $5.80.

THE FREMONT CULTURES: THEIR POSITION IN SOUTHWESTERN PREHISTORY

(L. C. Card No. Mic 58-1003)

Dee Calderwood Taylor, Ph.D.
University of Michigan, 1957

The purpose of this study is to report the nature and cultural relationships of archeological remains at two sites in Sevier County, Utah, and to relate the Fremont Cultures to other prehistoric groups in the Southwest. The report of these sites is important because (a) it describes the culture of prehistoric inhabitants in an area heretofore unreported, and (b) an analysis of the data permits new inferences to be drawn about the origin, distribution, and cultural relationships of the Fremont cultural groups.

The paper is divided into two sections. Part I is a site excavation report. This section describes the environmental setting, the techniques of excavation, the features found, and the artifacts recovered from the Sevier County sites. An analysis and comparison of the cultural traits shows that the sites belong in the Fremont Culture but have similarities and strong connections with cultures in other areas of Utah.

Part II considers the cultures in the "Northern Periphery" of the Southwest. A chapter describes the environment of the Colorado Plateau and the eastern edge of the Great Basin and summarizes the Fremont, "Puebloid," and "Western Pueblo" cultures in these areas. This section suggests that all of the Southwestern cultures have their beginnings in an ancient "Desert Culture" base, known from Great Basin sites to have existed about 10,000 years ago. Many Great Basin traits in the Fremont and Anasazi cultures came from that base.

Other sites attributed to the Fremont Culture are reviewed, the cultural traits summarized for each, and an overall description of the Fremont Culture synthesized from the data. The Fremont Culture shares many Anasazi traits but has unique developments of its own. A discussion of the "Puebloid" sites in western Utah shows them to be more like Fremont than Anasazi, and new names are suggested for these cultures to indicate this similarity. A final discussion considers why the sedentary farming sites were abandoned and what happened to the peoples of the Fremont Cultures. Some of the peoples may have followed the Anasazi south; others may have abandoned horticulture and eventually become the historic Ute-Paiute groups.

The Fremont Cultures developed along the northern edge of the Southwest and share many traits with groups in the Great Basin, the Anasazi, and other Southwestern cultures. Cultural traits from the Anasazi and the Plains were blended with indigenous specializations and local development to form a recognizable cultural entity existing during the period from A. D. 500 to A. D. 1270.
311 pages. $4.00.

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ASTRONOMY

AN EMPIRICAL DETERMINATION OF THE TURBULENCE FIELD IN THE SOLAR PHOTOSPHERE BASED ON A STUDY OF WEAK FRAUNHOFER LINES

(L. C. Card No. Mic 58-1013)

John Henry Waddell III, Ph.D.
University of Michigan, 1957

The purpose of the present investigation was to establish the mechanism of line formation in the solar atmosphere from the observed center-to-limb variation of the profiles of weak Fraunhofer lines. This study is based on profiles obtained with a 1P21 photomultiplier and the 50-foot focal length Ebert type vacuum spectrograph of the McMath-Hulbert Observatory, in which spectrographic "seeing" is eliminated by evacuation of a 52-feet long, 4-feet diameter steel tank which encloses the slits, mirrors, and grating. A 6 x 8-inch Babcock grating with 600 grooves per millimeter is the principal dispersing element. Tests show that the full theoretical resolving power (600,000 in the fifth order) is achieved, although for the present observations the effective resolving power was reduced to approximately 300,000 because wide slits were used - about 125μ. Scattered light and ghosts add up to 3.6 per cent of the continuum intensity. It is shown that the corrections for instrumental profile, scattered light, and ghosts are small and can be reliably applied. The principal error in the profiles arises from uncertainty in establishing the position of the continuum. The final profiles have an absolute accuracy of 0.5 per cent of the continuum and a relative accuracy of 0.2 per cent for the same line referred to different parts of the solar disk.

Five lines of Fe I (excitation potential 4 volts), four lines of V I (e.p. 0.3 and 1.0 volts) and two of Ti I (e.p. 1.0 volt) were observed in the wavelength region $\lambda\lambda$5300-6200. The observations of these lines at six positions (Cos θ = 1.0 to 0.25) on a 6-inch image of the sun permitted one to distinguish between the angular and depth effects in the formation of absorption lines.

In the analysis, use was made of the exact method of weighting functions proposed by Pecker. The lengthy computations were carried out on the IBM 650 at the Statistical Research Laboratory. The results indicate that the assumption of a non-isotropic turbulence in the high photosphere is sufficient to account for the observed center-to-limb variations of the half widths and the central intensities of all the lines studied. The best fit to the observations gave a radial random turbulent velocity of 1.8 $\pm$ 0.1 km/sec and a tangential random turbulent velocity of 3.0 $\pm$ 0.3 km/sec. The agreement between computed and observed central intensity was within 1 per cent for all the lines studied and within 0.5 per cent for the more reliable lines. Likewise, a close agreement was obtained between the computed and the observed half widths.

Furthermore it is shown from the contribution functions of lines of different excitation potential and hence of different depth of formation, that the above turbulent parameters do not vary with depth in the atmosphere for optical depths Log τ = -1.0 to -0.60. The effects of temperature inhomogeneities, departures from local thermodynamic equilibrium, and the effects of the energy spectrum are shown to be of slight importance. It is therefore concluded that non-isotropic turbulence physically represents conditions in the solar photosphere. It is further concluded that the total turbulent energy is not a function of depth, although the energy spectrum may suffer some distortion with height. 134 pages. $2.00.

BACTERIOLOGY

A STUDY OF THE MECHANISM OF RESISTANCE OF CULTIVABLE STRAINS OF TREPONEMA PALLIDUM TO STREPTOMYCIN, PENICILLIN, AND CHLORAMPHENICOL

(Publication No. 25,434)

Louis G. Austin, Ph.D.
The Ohio State University, 1953

The Treponema occupy an anomalous position between the protozoa and the higher bacteria. Ever since Treponema pallidum was first observed and established as the etiological agent of syphilis, efforts have been made to determine the true biological nature and relationship of this important group of microörganisms. Inability to cultivate the organism in vitro while conserving its virulence has presented an unsurmountable difficulty.

In attempts to cultivate the organisms from syphilitic lesions, many cultivable strains of treponemes, such as Reiter, Kroo, Noguchi, Nichols, and Kazan, have been isolated. While some authors consider these strains to be rough variants of Treponema pallidum, others regard them as contaminating saprophytes present in the lesions. Although their true relationship is still unsettled, it is suggested that the in vitro investigations of these strains may give a great deal of information applicable to the virulent treponemes and also of general bacteriological interest.

The phenomenon of "drug-fastness" which has been

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observed both with chemotherapeutic agents and antibiotics has become a major problem in the therapy of certain infections. Therefore, conclusions resulting from studies of the mechanisms of antibiotic resistance in microörganisms may have clinical significance. Finally, the study of treponemal resistance may aid in establishing the true relationship between the cultivable and virulent strains of Treponema pallidum. The current views regarding antibiotic resistance in microörganisms are as follows:

1. Resistance is an inherited characteristic originating through "spontaneous mutation."
2. Resistance is present before exposure of the organisms to the antibiotic and depends on the presence of antibiotic-inhibitor in the resistant organisms.
3. The resistant cells are in a dormant, non-dividing phase which is not susceptible to the action of the antibiotic.
4. Resistance is due to a change in the cell's center of organization, that is, to alteration of the velocity of growth or enzymatic activities.

Of these views, the first has found the greatest support. According to this view a bacterial culture is a nonhomogenous system which is giving off resistant mutants at a constant rate. By inhibiting the growth of susceptible cells, the antibiotic acts as a selecting agent making conditions more favorable for the resistant mutants. Thus, the antibiotic plays only a passive role in the appearance of resistance. Recently, however, many authors have questioned this view because of experimental results which are at variance with it.

In the present investigation cultivable strains of Reiter and Nichols Treponema pallidum resistant to penicillin, streptomycin, and chloramphenicol are described. The possible mechanisms by which the resistance was developed are also discussed.

The Reiter and Nichols cultivable Treponema pallidum were propagated in serum-enriched Brewer's thioglycollate and brain-heart infusion media. The inhibitory antibiotic concentrations for the original treponemes were established as .017 unit per ml., 9.5 γ per ml., and .1 γ per ml. of penicillin, streptomycin, and chloramphenicol respectively. Exposure of the treponemes to stepwise increments of the above antibiotics resulted in the development of variants resistant to 275 units of penicillin per ml., 25,000 γ streptomycin per ml., and 20 γ chloramphenicol per ml. The above variants were sixteen thousand-fold as resistant to penicillin, twenty-five hundred-fold as resistant to streptomycin, and two hundred-fold as resistant to chloramphenicol as the susceptible parent strains. After prolonged cultivation in antibiotic-free media, the penicillin and streptomycin-resistant variants showed no diminution in resistance. Under the same procedure chloramphenicol-resistant variants showed a hundred-fold loss of resistance.

The streptomycin-resistant variants showed a fifteen thousand-fold increase in resistance to penicillin and a fifty-fold increase in resistance to chloramphenicol over the parent strains. The penicillin-resistant variants showed a tenfold increase in resistance to streptomycin and a six hundred and twenty-five-fold increase in resistance to chloramphenicol over the original strains, while the chloramphenicol-resistant variants showed a fifteen-fold increase in resistance to streptomycin and a twelve-fold increase in resistance to penicillin.

A small, but significant, increase in resistance was attained by a single exposure of the treponemes to sublethal concentrations of penicillin and streptomycin. Likewise, prolonged exposure of treponemes to a constant sublethal concentration of streptomycin resulted in the development of variants with the same resistance as that obtained by exposure of the organisms to stepwise concentrations of the antibiotic. By a similar procedure penicillin-variants were obtained resistant to fifty units penicillin per ml. When a similar procedure was used, except that the cultures were stored in the refrigerator at 4°C., no resistance to either antibiotics was obtained. Prolonged exposure of treponemes to any concentration of chloramphenicol resulted in death of the cells after three of four months subculturing.

When suspended in triple-distilled water the parent cells rapidly formed "cysts." At acid pH the "cysts" were formed more rapidly than at alkaline pH. On the other hand, streptomycin- and penicillin-resistant variants did not form cysts in distilled water, under the above conditions. Hourly subcultures showed that resistant variants survived in distilled water two to ten times as long as the parent strains under both aerobic and anaerobic conditions. While change in pH greatly influenced the survival time of the parent strains, it had no effect on the survival time of the resistant variants.

No growth of the parent strains was obtained in media containing more than 60 per cent serum. However, the resistant variants grew well in all concentrations of serum, up to and including 100 per cent. Growth in serum alone was scanty but significant. Media containing no sodium thioglycollate or other reducing agents would not support growth of the parent strains but growth of these strains occurred in media containing .01 to 9.5 per cent sodium thioglycollate. On the other hand, media containing none to 6.5 per cent sodium thioglycollate supported adequate growth of the resistant variants.

Embryonated eggs made anaerobic after inoculation by being coated with paraffin, a process which killed the embryo, supported growth of both the resistant and parent strains. While the resistant variants survived after four subcultures in aerobically incubated embryonated eggs, the parent strains survived less than one day.

Complement-fixation tests in which the parent strain antigens and antisera were employed gave stronger reactions than heterologous systems in which the parent strain antigens were used with resistant variant antisera and vice versa. Absorption of the resistant variant antiserum by the parent strain antigen removed all antibody to the parent strain although a significant quantity of resistant variant specific antibody remained. Homologous absorptions of resistant and parent strain antisera respectively removed all antibodies for both antigens. Likewise, absorption of parent strain antiserum with resistant variant antigen removed practically all antibodies for both antigens.

Finally, complement-fixation test with Wassermann and brain extract antigens gave similar reactions with both resistant and parent strain antisera, respectively. However, similar tests with human syphilitic serum gave stronger reaction with the parent strain antigen than with the resistant variant.

Susceptibility of the parent Reiter and Nichols treponemes demonstrated that under favorable conditions for multiplication cultivable treponemes show the same

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sensitivity to penicillin, streptomycin, and chloramphenicol as other bacteria. Maximal resistance of sixteen thousand-fold to penicillin, twenty-five hundred-fold to streptomycin, and two hundred-fold to chloramphenicol, which was obtained by constant cultivation in stepwise increments of the antibiotics, showed that with adequate duration of exposure it is possible to develop variants of treponemes resistant to high concentrations of antibiotics. Earlier failures to obtain antibiotic-resistant variants of these treponemes may have been due to inadequate length of exposure to the antibiotics.

The remarkable degree of cross resistance shown by the respective resistant variants above may suggest an antibiotic induced mutation. The mutagenic effect of the antibiotics would be non-specific. Thus, it is likely that while the penicillin-resistant centers were being affected, the chloramphenicol-resistant centers were also being affected simultaneously.

Single exposure to sub-lethal concentrations of streptomycin and penicillin resulted in the development of a significant amount of resistance. In the same way, prolonged exposure, of several months, to constant sub-lethal concentrations of antibiotics resulted in development of streptomycin-resistant variants with the same high resistance as that which was obtained by cultivating the organisms in stepwise concentrations of the antibiotic. However, penicillin-resistant variants obtained by similar procedures showed less resistance than variants obtained by stepwise cultivation. In the above experiments several independent cultures of both Reiter and Nichols strains were used. In all cases the degree of resistance obtained for independent cultures was the same. Although the mechanism of resistance may have been one of selection of preformed resistant mutants present in the original cultures, the constancy of the results obtained both in single and prolonged exposure from one independent culture to another and from strain to strain may suggest that the presence of the antibiotics increased the mutation rate. The mutagenic effect of the antibiotics may have been exerted either on "zero point" or "end-point" mutation. The fact that exposure of non-dividing cells, in the refrigerator, failed to bring about development of resistant variants indicated that spontaneous mutation and selection could not be ruled out completely.

Although a two hundredfold resistance to chloramphenicol was obtained by subculturing in stepwise concentrations of the antibiotic, its mechanism seemed to be of a different nature than the resistance outlined above. In the first place, subculturing of chloramphenicol-resistant variants in antibiotic-free media resulted in a hundredfold decrease in resistance. In the second place, prolonged cultivation of the above treponemes in any concentration of chloramphenicol eventually led to their death. Thus, it appears that the treponemes developed high tolerance but not resistance to chloramphenicol. On the other hand, it may have been that during the continued exposure to chloramphenicol the cells mutated to maximal resistance but that this mutation may also have been associated with a lethal mutation. However, it is also possible that the death of the exposed cells may have been due to a cumulative effect of the antibiotic.

When suspended in distilled water, the original strains of treponemes rapidly formed cysts. Maximal survival time of the original strain in distilled water, both under aerobic and anaerobic conditions, was two to four hours. Lowering of the pH hastened cyst formation and decreased the survival time. The streptomycin- and penicillin-resistant variant treponemes did not form cysts under similar conditions. The survival time of these variants in distilled water, under above conditions, was two to ten times that of the parent strains. Change in pH had no effect on cyst formation or survival time of these treponemes. It has been suggested by many authors that cyst formation is related to a treponemal life cycle. It is here suggested that the cyst formation in young treponemal cultures which was induced by changes in osmotic pressure, pH, and quality of media, is purely a surface phenomenon and not related to a life cycle of the organisms. The inability of the antibiotic-resistant variants to form cysts may be related to alterations of the cell surface during the development of resistance. The alterations may have resulted from such profound changes in the resistant variants that they were not susceptible to the same surface phenomena as the parent strains. On the other hand, cyst formation in old cultures may be due to other mechanisms. It is noteworthy that there was no observable difference between cyst formation in aged parent strain and the resistant variant cultures. It may be that the cysts formed in old cultures are related to a life cycle, as suggested by some investigators.

Growth of the Nichols parent strain was obtained in culture media containing serum concentrations ranging from 1 to 60 per cent and sodium thioglycollate concentrations of .01 to 9.5 per cent. In contrast, the Nichols streptomycin-resistant variants grew in media containing various serum concentrations and even in serum alone. It also grew in media containing sodium thioglycollate ranging from none to six per cent. It is suggested that during the process of becoming resistant changes occurred in other characteristics. Consequently, the resistant variant cells were not as sensitive to atmospheric oxygen as the parent strain cells. These variants were also able to obtain all their nutritional requirements from serum alone.

Both resistant and parent strains grew well in paraffin-coated embryonated eggs. However, the parent strain organisms did not survive the first subcultures in aerobically incubated embryonated eggs. Under similar conditions the resistant variants survived four subcultures. As suggested above, it is possible that atmospheric oxygen tension has toxic effects on normal treponemes. Thus, the parent cells rapidly undergo cyst formation when exposed to atmospheric oxygen as they do under changed osmotic conditions, such as suspension in distilled water. However, resistant variant cells not being so sensitive to atmospheric oxygen do not form cyst under the same conditions. Thus, survival of the resistant variant cells in the absence of growth was extended under these conditions, a phenomenon analogous to a similar one in distilled water. It is suggested that with proper manipulation it may be possible to adapt the resistant variant treponemes to grow in living embryonated eggs.

It has already been mentioned that heterologous absorption of resistant variant antiserum removed practically all antibody for the parent strain antigen, leaving a significant amount of antibody specific for the resistant variant antigen. The resistant variants thus seemed to possess the antigenic characteristics of the parent strain treponemes. However, they also contain a distinct antigenic fraction which evoked the production of specific

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antibodies. It is possible that this antigenic fraction is more quantitative than qualitative in that the parent strain may contain minute amounts of it. During the process of developing resistance, this small fraction may then have increased at the expense of the other antigenic fractions.

The ability of the resistant variants to survive under aerobic conditions, their ability to multiply in serum alone, as well as their inability to form cysts in young cultures may be related to the presence of the specific antigenic fraction observed above. It is conceivable that the presence of this fraction changed the surface characteristics of the cells and thus modified their response to surface phenomena.

Results obtained with Wassermann and brain extract antigens with both the resistant and parent strain antisera indicated that the corresponding antigenic fractions were not modified during the development of resistance. However, the results obtained with human syphilitic serum and the resistant variant antigen were contradictory and indicated that the development of antibiotic resistance may have modified the ability of the treponemal cells to detect antibodies in human syphilitic serum.

In summary, the following points may be recapitulated. By continuous cultivation in stepwise concentrations of the respective antibiotics, variants of the cultivable treponemes were obtained which were resistant to high concentrations of streptomycin, penicillin, and chloramphenicol. An unusually high degree of cross resistance was observed in the above variants. Resistance was also developed to streptomycin and penicillin by a single exposure of the treponemes to sub-inhibitory concentration of the antibiotics as well as by repeated subculturing in a constant sub-inhibitory concentration of the antibiotics over a long period of time. All attempts to develop resistance by exposing the undividing treponemal cells to the antibiotics failed. Marked differences, such as cyst formation and survival under various conditions, were observed between the parent strain and the resistant variant cultures. Serological tests indicated the presence in the resistant cells of specific antigenic fraction not detected in the parent strain cells. Finally, the possible mechanisms of development and behavior of treponemal resistance were discussed. 116 pages. $2.00. Mic 58-4783

Abstract published by special arrangement with The Ohio State University.

FACTORS IN ERYTHROPHAGOCYTOSIS BY TISSUE CULTURE MACROPHAGES

(Publication No. 25,428)

Joe Alonzo Bass, Ph.D.
The Ohio State University, 1953

Ever since the original observations of erythrophagocytosis by Metchnikoff, various investigators have suggested this as the means for the removal of damaged or senile erythrocytes. A large portion of the observations have dealt with erythrophagocytosis by the circulating leukocytes. In many instances, however, the macrophages have been involved.[1,2,3,4] Furthermore, the concept that the spleen is responsible for the removal of old erythrocytes, and possibly leukocytes and platelets, in the normal individual has gained wide acceptance.[5,6,7]

However, the mechanisms of erythrocyte destruction most frequently considered in those clinical states characterized either primarily or secondarily by an anemia not attributable to inadequate erythrocyte production have been fragmentation[8,9,10] and hemolysis.[11,10,12] Thus, the predisposing traumatic factors, either non-specific or specific, such as incomplete antibodies in many cases of acquired hemolytic anemia, have been implicated as hemolysins rather than as opsonins. The reluctance in accepting phagocytosis as a major means of removal of the damaged erythrocyte has been due in part to the failure of many investigators to observe significant erythrophagocytosis by macrophages in tissue sections of the spleen prepared in the usual manner.

Doan and his co-workers, on the other hand, have repeatedly emphasized the role of erythrophagocytosis in the destruction of the normal and abnormal erythrocyte.[13,6,14,15] These workers have stressed the fact that the spleen affords three conditions conducive to phagocytosis: (1) the high concentration of macrophages in the red pulp; (2) the blood reservoir function of the organ; and (3) the unique splenic structural interrelationships between the sinusoids and pulp spaces. They have further postulated that hyperfunction of the spleen (viz. hypersplenism) --that is, hypersequestration of the red cells and/or hyperactivity of the macrophage in its erythrophagocytic role--may account for the excessive destruction of erythrocytes in some of the anemic states.

In order to examine the premise that erythrocytes from cases characterized by an anemic state might be more susceptible to phagocytosis by the macrophages in splenic tissue, an in vitro test roughly simulating in vivo conditions was sought. The use of splenic macrophages cultivated in vitro was deemed the most practical approach to the problem of establishing a grossly quantitative test.

In every phagocytic test three factors are in operation: (1) the phagocyte; (2) the surrounding medium; (3) the cell or particle to be phagocytized. Therefore, in order to eliminate factors other than the modification of the red cells used, a study was made of the conditions necessary for the stabilization or standardization of the phagocyte and the medium. At the same time, other quantitative aspects of the test, such as optimal incubation time, optimal concentration of red cells, and the best method for determining the phagocytic index (P.I.) were studied.

The method used for culturing macrophages was a modification of the cover slip method as partially described by Cameron[16] and Parker.[17] Spleens were removed aseptically from young domestic rabbits. The capsule was dissected away and the tissue minced into pieces approximately 0.5 to 1 mm. in diameter. The splenic tissue was rinsed several times with Earle's solution.[16]

Glass rings 5 mm. wide with an outside diameter of 20 mm. were dipped in sterile, melted paraffin, and placed on round cover slips. Several explants were placed on each cover clip and allowed to dry at room temperature. Three or four drops of nutrient medium were added. Nutrient medium consisted of a mixture of 40 parts fresh pooled rabbit serum, 60 parts Earle's solution, and 100 units each of Penicillin G potassium and dihydrostreptomycin. An ordinary 1 x 3 inch microscope slide was warmed over an alcohol lamp and placed on the ring, the melted paraffin giving a temporary seal. Cultures were further sealed

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with a 4:1 paraffin-vaseline mixture and incubated at 37° C. for 48 hours, after which they were inspected for growth under low power. Fluid of satisfactory cultures was replaced with freshly prepared nutrient medium, the cultures resealed and incubated another 24 hours.

Whole blood was collected in balanced oxalate or ACD (Baxter) as anticoagulant. Erythrocytes were washed three times with phosphate buffered saline (pH 7.4) and then diluted with Earle's solution to a 0.3 per cent suspension. Serum used routinely for the tests consisted of a mixture of 80 parts rabbit serum, stored 24 hours at room temperature, and one week at 5° C. and 20 parts Earle's solution.

Suitable test cultures were reopened and the nutrient fluid drawn off. Two drops each of cell suspension and test serum were added. Cultures were resealed and incubated for the appropriate incubation time, separately determined for each type of cell or cell modification used. Examination for phagocytosis was then made with the preparation inverted, using 430X magnification.

When three- to five-day-old cultures of rabbit spleens, prepared as described, were observed before the addition of the test cells, large numbers of living macrophages could be observed growing out from the explant on the cover slip. Since some of these macrophages already contained easily identifiable erythrocytes from the rabbit from which they were obtained, the number of these present in a total of fifty macrophages served as a base line to be subtracted from the count obtained after addition of the test cells. A total of fifty macrophages per culture were inspected for: (1) the number of macrophages containing red cells; and (2) the number of red cells ingested. The base line counts were subtracted and the results finally expressed as the percentage of macrophages showing phagocytosis of the test cells. This was selected as the standard phagocytic index (P.I.), since this type of count was found to be more consistent and accurate.

The P.I. values of the cells of normal rabbits ranged from 0 to 13 per cent, with an average value of 5.4 per cent. Normal rabbit erythrocytes sensitized with isoimmune rabbit erythrocyte serum showed an average P.I. of 54 per cent, with a low of 39 per cent and a high of 69 per cent. Rabbit erythrocytes treated with a 1 per cent trypsin solution for 30 minutes had an average P.I. of 83 per cent, with a range of 68 per cent to 94 per cent.

It was originally assumed that human cells would have a higher P.I. in cultures of rabbit macrophages because of the species difference and the possible opsonizing action of normal rabbit serum. However, normal human cells were not phagocytized to a significantly greater degree than rabbit cells. The red blood cells of 72 normal individuals of both sexes and with a range in age from infancy to 77 years were phagocytized within the fairly limited range of P.I. values of -8 per cent to + 12 per cent. (The negative values are explained by a greater base line value than was obtained after incubation with the test cells.)

Normal human erythrocytes sensitized with human anti-A, anti-B, and anti-Rh sera, as well as with rabbit anti-human erythrocyte serum, had an average P.I. of 30 per cent. Trypsin treatment of normal human erythrocytes raised P.I. values to an average of 58 per cent. Treatment of human erythrocytes with influenza virus, strain PR-8, and with Newcastle Disease virus also raised the P.I. significantly. Phagocytic values for both rabbit and human erythrocytes were increased markedly by treatment with old tuberculin. The effect of storage of erythrocytes as whole blood was variable, with P.I. values having no relationship to the duration of storage.

Erythrocytes from irradiated rabbits, as well as rabbit and human red cells irradiated in vitro showed no increased susceptibility to phagocytosis.

The effect of normal human sera on phagocytosis of trypsin-treated human erythrocytes by rabbit macrophages was extremely variable. Several samples were highly toxic for the macrophages. Only 2 or 21 samples promoted as high a degree of phagocytosis as that obtained with stored rabbit serum. Attempts to remove inhibitory or toxic factors by heat inactivation or absorption with minced rabbit spleen tissue produced inconsistent results.

The low range in phagocytic index obtained with the normal rabbit erythrocytes was to be expected, since theoretically any sample of normal blood should contain only a small percentage of cells approaching susceptibility to destruction. The failure of the rabbit macrophage to recognize any species difference when normal human erythrocytes were tested, though unexpected, was not too surprising in view of the fact that Bloom[3] had shown that normal pigeon erythrocytes were not phagocytized to any extent by macrophages cultured from rabbit lung tissue. However, species specificity was evidenced with other cells; the P.I. for normal mouse cells, for example, was 28 per cent.

The opsonizing action of trypsin treatment was of a high degree when tests were conducted with stored (test) rabbit serum. However, optimal values of 80, 72, 42, and 70, obtained with stored serum, were lowered to 19, 33, 2, and 2, respectively with fresh, heated serum, even though marked agglutination of the cells was evident. Addition of small increments of fresh serum to the heated serum increased the P.I. to within the range obtained with the fresh and stored sera, with a concurrent increase in lysis of non-ingested cells. Also, when trypsinized erythrocytes were tested in the absence of serum, an average P.I. of 8 per cent was obtained, in contrast to values of 64 – 74 per cent obtained with 10 – 50 per cent concentrations of serum in the test. It is evident that a high concentration of serum proteins is not necessary for optimal phagocytosis; further, the small amount of serum necessary for optimal phagocytosis suggests that the activity of the serum is directed toward the treated erythrocyte, rather than the macrophage.

On the basis of the data, it appears justifiable to postulate that the changes in antigenicity which are brought about by trypsin treatment of human red cells[15, 18, 19] expose new groups with which the naturally occurring heat-stable agglutinin in normal rabbit serum can react. A heat-labile, complement-like opsonin, active in very small amounts, greatly enhances the moderate opsonic activity of the heat-stable agglutinin.

The opsonic activity of immune serum is well known.[2, 3] In the present experiments, sensitization was shown to enhance greatly the phagocytosis of both the rabbit and human erythrocytes. However, when sensitized cells were tested in the absence of rabbit test serum, phagocytosis was within the normal range, even though agglutination of erythrocytes was marked. Thus a heat-labile factor may also be necessary for optimal phagocytosis of normal erythrocytes sensitized with either iso-immune serum or with antiserum produced in another species.

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The optimal incubation time, that is, the incubation time at which the highest P.I. values were obtained, was found to vary from 30 to 35 minutes for the sensitized human erythrocyte, and 20 to 35 minutes for the trypsin-treated cell. With sensitized rabbit cells, the highest readings were obtained from 25 to 35 minutes, and with the trypsinized, 20 to 30 minutes. Beyond these optimal incubation times, the P.I. dropped rapidly, a fact which was shown to be caused by rapid digestion of the engulfed erythrocytes. On the other hand, 2 to 4 hours elapsed prior to digestion of ingested normal erythrocytes.

When a series of tests employing concentrations of cells ranging from 0.004 per cent to 1.00 per cent were conducted, it was found that P.I. values increased in a linear fashion until a near maximum value was reached at a concentration of 0.062 per cent, and then rose only very gradually with the higher concentrations. This apparent rise, however, was within the margin of error of the test. Thus it would seem that as the concentration of cells was increased over the lower range, the number of collisions increased proportionately, and was reflected in the phagocytic index.

When mixtures of trypsin-treated and normal cells were tested, a roughly constant increase was noted in P.I. in relation to the increases in percentage of from 5 per cent to 30 – 40 per cent of trypsin-treated cells. P.I. values then remained constant through approximately 60 – 65 per cent concentrations of treated cells. At this point, further increases in susceptible cells were again reflected in P.I. in two of the three experiments conducted. Perhaps interference by normal erythrocytes prevented P.I. values from reaching a maximum when the percentage of trypsinized erythrocytes approached 40 per cent of the 0.15 per cent final test suspension, that is, a concentration of 0.060 per cent trypsin-treated cells in the mixture, shown to be sufficient for maximal phagocytosis in the cited cell concentration experiments.

There were four groups of diseases to which application of the phagocytic index was made: the hemolytic anemias, malignancies, infectious diseases, and a miscellaneous group comprised of disease entities which at times show varying degrees of excessive peripheral blood destruction. In all except two of the acquired hemolytic anemias tested P.I. values were greater than the maximum value (12 per cent) shown by any normal individual. In all of the 7 cases of hereditary spherocytosis the P.I. was elevated. One erythroblastotic infant tested the day after delivery has a P.I. of 39 per cent; in another infant, one week old, the P.I. was 17 per cent. Neither the single thallasemis major nor the two sickle cell anemias were appreciably elevated.

In the miscellaneous group it was noted that all of the six essential thrombocytopenic purpuras had elevated P.I. values. Erythrocytes from cases of splenic neutropenia, Felty's syndrome, and Banti's syndrome all had elevated indices.

The chance observation that the P.I. was elevated during minor infections such as coryza led to more extensive application in a series of infectious diseases. The largest single group of infectious diseases was 49 cases of tuberculosis with a median P.I. of 25. In all except 8 of these cases the P.I. was larger than the maximum value shown by any normal individual (12 per cent). In two cases of tuberculosis meningitis values were increased. P.I. values were also elevated in gas gangrene, tetanus, brucellosis, streptococcal infection, infectious mononucleosis, hepatitis, acute rheumatic fever, and four undiagnosed cases tentatively categorized as infectious diseases.

The recent interest in the short-lived erythrocyte in many instances of malignant disease[21,22,23] suggested investigation of erythrophagocytosis in this group. The range of values found was from 2 per cent to 93 per cent. The 13 cases of skin cancer, with a median of 12 per cent, appeared to have the lowest phagocytic indices. The 20 malignancies having metastasis had a median of 43.5 per cent.

Attempts to correlate P.I. with the clinical state of the patients tested have met with little success. In an analysis of a number of cases of acquired and congenital hemolytic anemia, there was no definite correlation between the degree of phagocytosis and the number of peripheral red cells, the percentage of reticulocytes, the mechanical fragility, anti-trypsinized cell titer, or direct Coomb's titer.

Any interpretations based on the findings on erythrocytes alone, however, must be viewed with caution, inasmuch as factors other than the red cell itself must be considered. Thus, a hyperactivity of the macrophage and of the spleen as a whole has been postulated by Doan and his co-workers.[6,13,14,15]

Also, the present experiments with rabbit serum suggest that optimal phagocytosis may be limited by the amount of heat-labile, complement-like opsonin in the serum, a component which may be exhausted in the presence of large numbers of altered erythrocytes in vivo. Further, the limited experiments with human serum suggest the existence of stabilizing influences which have been minimized or removed in this test. Any further correlation between the P.I. and the shortened survival or life span of erythrocytes in hemolytic processes will require more knowledge of the modifying factors and of the in vivo forces tending to stabilize the cells.

Nonetheless, regardless of the role played by the macrophage and the surrounding medium or serum, the statistical evaluation of quantitative differences in those diseased individuals tested compared with normal persons supports the belief that the test detects changes in red cells which make them susceptible to phagocytosis and that erythrocyte modifying factors of various kinds are at work in disease. 86 pages. $2.00. Mic 58-4784

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Abstract published by special arrangement with The Ohio State University.

PERMEABILITY ALTERATIONS ASSOCIATED WITH CHLORAMPHENICOL RESISTANCE IN MICROCOCCUS PYOGENES VAR. AUREUS

(L. C. Card No. Mic 58-589)

Robert Edward Bowling, Ph.D.
The University of Oklahoma, 1957

Major Professor: H. H. Ramsey

Chloramphenicol sensitive and resistant strains of Micrococcus pyogenes var. aureus were compared by several means in order to determine possible differences in permeability features and the relation, if any, to chloramphenicol resistance.

A resistant strain (Strain R) has been found less tolerant to salts (sodium chloride, potassium chloride, ammonium chloride, and magnesium chloride) than its sensitive counterpart (Strain S). The restoration of salt tolerance in Strain R by serial subculture in increasing salt concentrations resulted in a decrease in chloramphenicol resistance.

The combined inhibitory effects of chloramphenicol and sodium and potassium chlorides on both strains were additive in most concentrations and frequently synergistic.

The combined effects of chloramphenicol and polymyxin B (a surface-active agent) were synergistic; the synergism was more pronounced in Strain R than in Strain S, although there was no difference in the response of the two strains to polymyxin alone.

Strain R was found to be more active than Strain S in assimilating and binding isotopically labeled lysine and glutamic acid, especially in the presence of an energy source (glucose). This activity was inhibited by 2,4-dinitrophenol and by incubation at 0^0 C, suggesting that active transport of lysine may be more important than previously reported. The assimilation and binding of glutamic acid were moderately inhibited by chloramphenicol, while assimilation and binding of lysine were inhibited only slightly, if at all.

No evidence for removal of chloramphenicol from solution by resting and growing cells of the two strains could be obtained.

It is concluded that Strain R exhibits greater permeability and more highly developed active transport mechanisms than Strain S, and may owe its resistance, in part, to these features. 72 pages. $2.00.

THE ROLE OF SURFACE MEMBRANES IN BACTERIAL PERMEABILITY

(L. C. Card No. Mic 58-885)

Eugene Maurice Britt, Ph.D.
University of Michigan, 1957

The role of surface membranes in bacterial permeability was studied first by comparing the intracellular pooling of lysine in intact cells and protoplasts of a lysozyme-sensitive bacterium. Preliminary studies confirmed the published data on the extent of lysine pooling in Bacillus megaterium and Micrococcus lysodeikticus. Additionally, the published data on protoplast formation

from B. megaterium were confirmed. It was independently shown that, under specific conditions of tonicity and lysozyme concentration, protoplasts also could be formed from M. lysodeikticus and that raffinose, glucose, and sodium chloride could be substituted for sucrose as a stabilizer. Several methods were used unsuccessfully in attempts to isolate lysozyme-sensitive mutants of other bacteria. Because M. lysodeikticus to the greater degree possessed the combination of characteristics which were suitable for these permeability studies, it was chosen as the test organism.

Using for assay a crude, cellular and a purified, cell-free lysine decarboxylase from Bacterium cadaveris, it was found that the lysine pool in M. lysodeikticus could be depleted to non-detectable levels when the cells were incubated at 37° C in an aerated, nitrogen-free medium containing a utilizable carbohydrate as an energy source. Data were obtained which suggested that starved cells of M. lysodeikticus can internally replenish their intracellular lysine pool in the absence of exogenous nitrogen when an energy source is supplied; magnesium may be an essential cation for the probable enzymatic mediation of this process.

When lysine-starved protoplasts were prepared from M. lysodeikticus and exposed to exogenous lysine under conditions precluding internal replenishment, it was found that these structures pooled lysine to a concentration at least equal to that in similarly treated intact cells. The pool levels in both cases were less than those in the original cells before starvation. An increase in temperature from 4° to 37° C increased the level of pooling in both protoplasts and intact cells whereas a ten-fold increase in the concentration of exogenous lysine was without significant effect. The pooled lysine represented only five to ten per cent of the total uptake of lysine with the remainder being located extraprotoplastically; this finding was confirmed subsequently, using total uptake methods. It was concluded that the cell wall is not only unnecessary for lysine pooling but even may hinder the process.

Additionally, it was shown that the lysine pool did not "leak" from protoplasts which had been prepared from unstarved M. lysodeikticus. This negation of cell wall function in pool retention lent further credibility to the thesis that some structure other than the cell wall is the site of permeability for lysine in M. lysodeikticus.

Direct determinations were used to measure and compare the total uptake of lysine by large masses of intact cells and protoplasts. When corrected for intercellular volume, the uptake of lysine by intact cells amounted to 67 per cent of the cell volume, whereas protoplasts failed to take up measurable amounts of lysine. Of the lysine taken up by the intact cell pack, about half was recoverable by water washes, while all of the lysine taken up by the protoplast pack was recoverable by this treatment and could be accounted for as intercellular lysine. Thus, of the lysine taken up by intact cells, almost all appeared to be located extraprotoplastically. Since this region corresponds to that occupied by the cell wall, a large mass of purified cell walls of M. lysodeikticus was isolated and then was used to determine the uptake of lysine. These data revealed that cell walls are not only capable of sorbing but also of concentrating lysine by a process which appeared to be electrostatic in nature. 141 pages. $2.00.

'MALIC' ENZYME SYNTHESIS AS A MEASURE OF NUTRITIONAL INTERACTIONS IN LACTOBACILLUS ARABINOSUS

(L. C. Card No. Mic 58-1113)

Samuel Joseph Deal, Ph.D.
University of Minnesota, 1957

Lactic acid bacteria have been used frequently in studies concerned with the interactions of vitamins, amino acids and other growth factors. The usual technique has consisted of measuring quantitative changes in growth induced by the deletion and replacement of the various substances necessary for growth.

Since the metabolic patterns of growth are quite complex, it was thought possible that the synthesis of a single protein might offer a simpler technique for determining the role of growth factors in nutrition. Synthesis of 'malic' enzyme, which is inducible in Lactobacillus arabinosus, was found to be a suitable system since nutrition plays an important role in its induction. Furthermore, since carbon dioxide is evolved in the 'malic' enzyme system, conventional Warburg manometric techniques could be employed to follow the rate of enzyme synthesis.

Malic acid, amino acids and glucose were required for synthesis by washed cells of L. arabinosus grown in complete Wright-Skeggs medium. A phosphate buffer was used to maintain a pH of 5.5 throughout the extent of induction. Deletion of individual amino acids from the inducing menstruum revealed that the amino acid requirements for 'malic' enzyme synthesis were similar to the requirements for growth. Individual omission of glutamate, tyrosine, isoleucine, valine, leucine, tryptophan, phenylalanine, arginine, histidine, methionine and serine from an inducing medium of eighteen amino acids depressed to varying degrees the extent of enzyme synthesized. Cysteine and threonine required for the growth of this organism had no effect when deleted from the amino acid mixture. Some induction occurred in the absence of added amino acids which probably resulted from intracellular pools incurred during growth. However, attempts to deplete this pool resulted in deactivation of the enzyme forming system.

Amino acid replacement studies made during growth of this organism could also be demonstrated in induction. For example, arginine could be replaced by citrulline but not by ornithine, and L-glutamic acid, omission of which caused the greatest depression of synthesis, could be replaced by D-glutamic acid but not by alpha-ketoglutarate.

Vitamins had no effect on induction when added to cells grown in complete Wright-Skeggs medium; however, cells grown deficient in a vitamin required for growth were stimulated by the addition of the corresponding vitamin. On the basis of such studies biotin, pantothenic acid, nicotinic acid and pyridoxine were shown to be necessary for optimal enzyme formation. In agreement with observations made in growth, biotin deficient grown cells required aspartic acid for synthesis; furthermore, biotin, which could replace the aspartate requirement, was required for maximum enzyme synthesis even in the presence of complete Wright-Skeggs medium. Ammonium ions also stimulated the induction of cells grown deficient in biotin, and a synergistic effect was noted when biotin and ammonium ions were added together to the system.

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Pyridoxal had little effect on induction when added to a complete amino acid mixture; however, this vitamin could replace the requirement for aspartic acid, lysine and alanine. Since diphosphopyridine nucleotide (DPN) is a coenzyme for 'malic' enzyme activity, cells induced in the absence of nicotinic acid required this vitamin for the synthesis of the cofactor.

Acetate which is required for the growth of this organism had no effect on induction.

The nutritional requirements for the induced synthesis of 'malic' enzyme appear to be quite similar to the requirements for growth. Furthermore, the induction technique possesses certain advantages not present when growth is used as a parameter for nutritional and metabolic studies. The technique is simple and rapid, and it is not necessary to autoclave any of the factors required or studied in induction, a definite prerequisite for working with thermolabile substances. Proper controls, both nutritional and environmental, can be readily maintained. Cells can be grown under various conditions of nutrition and environment, thus permitting a method of investigating cells deficient in one or more factors. Hydrogen ion concentration, extremely variable during growth, can be kept constant during induction.

These comments are not intended to abrogate or even minimize the use of growth experiments since results obtained by use of the induction technique will have greatest value when correlated with those obtained by growth studies. 106 pages. $2.00.

A STUDY OF THE NATURE OF THE STIMULATORY EFFECT OF AUTOCLAVED GLUCOSE ON THE GROWTH OF PROPIONIBACTERIA

(L. C. Card No. Mic 58-1116)

Marvin Frederick Field, Ph.D.
University of Minnesota, 1957

The growth of four strains of propionibacteria from small inocula is delayed in synthetic media to which glucose has been added aseptically after autoclaving. Prompt growth routinely occurs in the same media which has been autoclaved with the carbohydrate. This growth stimulation is not specific for glucose since several other reducing sugars, when autoclaved with the medium, are effective in replacing glucose. Glyceraldehyde and glycolaldehyde are from four to eight times more active than glucose on a molar basis. Non-reducing compounds, e.g. glycerol, mannitol and sucrose, are inactive in producing the active heat reaction factor.

Of the several medium components, autoclaved mixtures of glucose, phosphate salts and casein hydrolysate (Casamino Acids, Difco) are necessary for optimal growth stimulation. Heated mixtures of glucose and phosphate salts occasionally demonstrate partial activity. Several amino acids, when heated individually with the glucose-phosphate mixtures, are highly effective in producing the activity. Glycine is the most active. The factor can be adsorbed with Norite A and part of the activity recovered from the charcoal by elution with 50 per cent ethanol.

In the absence of carbohydrate during heating, partial activity is provided by prolonged autoclaving (30 minutes) or by sterilization of the medium for the usual time period (10 minutes) at pH 5.0. Under the latter conditions, growth stimulation is not produced when purified amino acids are substituted for the acid hydrolyzed casein of the medium. It is suggested that an unidentified factor in acid hydrolysates of casein is important in growth initiation of these microbes.

N-D-glucosylglycine, glycyl-L-asparagine, asparagine, carbon dioxide and several dicarboxylic acids effectively replace the growth stimulation of autoclaved glucose media. These compounds, except carbon dioxide, were not stimulatory when purified amino acids were substituted for the casein hydrolysate of the medium. However, a completely synthetic medium has been devised for growth of propionibacteria employing purified amino acids in the medium and cultivation in an atmosphere of 10 per cent carbon dioxide. It is suggested that the "autoclaved glucose" effect supplies carbon dioxide or a carbon dioxide replacement compound necessary for early initiation of growth from small inocula.

With resting cells of Propionibacterium freudenreichii ATCC 6207, the rate of glucose utilization was found to increase two to three fold in the presence of acid hydrolyzed casein. The extent of stimulation depends on the concentration of added casein. A maximum effect is observed at 10 mg. per Warburg vessel (3 ml. volume) with 5 mg. bacteria (dry weight) and 50 micromoles glucose. The enhanced glucose disappearance is not a result of growth or additional enzyme synthesis since several antibiotics and ultraviolet irradiation of the cells have no effect on the degree of stimulation.

Enzymatically hydrolyzed casein and amino acid mixtures yield only part of the activity of acid hydrolyzed casein. Further treatment of these preparations with constant boiling HCl results in activity equal to the commercial acid hydrolysates. Of the amino acids, aspartic acid is active but only at higher concentrations (2.5-5.0 mg. per vessel). A combination of amino acids is apparently more effective than the single amino acids.

The fermentation of glucose is less sensitive to the action of fluoride, iodoacetate and semicarbazide in the presence of acid hydrolyzed casein or aspartic acid than in their absence. For example, in the presence of 0.001 M iodoacetate 90.5 per cent inhibition was observed for glucose utilization. The addition of 5.0 mg. of aspartic acid resulted in only 57.2 per cent inhibition with the same amount of iodoacetate. Similar results were observed for the other inhibitors. The possibility is suggested that aspartic acid or other factors in acid hydrolyzed casein enhance glucose utilization by these organisms by pathways other than the Embden-Meyerhof-Parnas scheme of glycolysis. 124 pages. $2.00.

USE OF ANTIBIOTICS IN THE PROCESSING AND PRESERVATION OF FRESH BEEF

(L, C. Card No. Mic 58-766)

Herbert Sam Goldberg, Ph.D.
The Ohio State University, 1953

Present methods for processing fresh beef after slaughter require immediate refrigeration to suppress the

bacterial growth in meat which results in spoilage. However, in addition to creating transportation and handling problems, refrigeration may retard the development of one of the desirable qualities of beef, namely, tenderness. Tenderization is believed to be due largely to the activity of autolytic enzymes acting on beef tissues during storage. Most biochemical reactions respond to temperature changes in such a way that for each 10 degree increase in temperature, up to the point where enzymes are destroyed, the reaction rate doubles or trebles. Therefore, tenderization under refrigerator conditions (1 C) proceeds considerably slower than at room storage (25 C) or at body temperature (37 C).

The dissertation is a study of the nature of internal spoilage and an investigation into the possibility of delaying the growth of microörganisms without immediate refrigeration of the carcasses. With such a delay fresh meat could be improved and its quality standardized.

The initial step was to determine if certain antibiotics which have been utilized in other areas because of their established antibacterial effect, low toxicity for man, and wide availability could be used to retard growth of bacteria in meat. The antibiotics penicillin, streptomycin, bacitracin, chloromycetin, terramycin, and aureomycin were first tested for their preservative effect in fresh ground beef. It was found that penicillin, bacitracin, and streptomycin were ineffective in delaying spoilage of ground beef held at 10 C. However, terramycin, chloromycetin, and aureomycin prolonged the storage life of ground beef from 5 to 9 days.

The three antibiotics that showed preservative activity in ground beef were tested upon 92 organisms previously isolated from deep tissues of beef. Of the three antibiotics tested, aureomycin inhibited the greatest number of beef isolates. On the basis of its preservative action in ground beef and its inhibitory effect upon organisms isolated from beef tissue, aureomycin was selected as the best antibiotic to test the preservation of whole beef.

A preliminary group of eight beef rounds were infused by means of the circulatory system with a physiological saline solution containing aureomycin. These rounds were refrigerated in the usual manner, and bacteriological and organoleptic studies were carried out on the beef. Results indicated that no undesirable effects regarding color, texture, taste, and general appearance were observed in the infused beef. Bacteriological analysis of lymph nodes revealed that the infusion of aureomycin appreciably reduced bacterial numbers in the infused nodes. Next, a series of ten infused rounds and controls were studied in a similar manner while stored at room temperature for 48 to 72 hours. Seven out of ten of the untreated rounds but none of the infused rounds revealed characteristics of spoilage at the end of the storage period. Further chemical, bacteriological, and organoleptic studies detected no undesirable conditions in the aureomycin infused meat, the possible exception being a 2.9 per cent increase in moisture.

Four additional rounds were infused with a physiological saline solution containing no antibiotic. Bacteriological examination of these rounds revealed that the infusion per se had no influence on the preservative action.

On the basis of the foregoing data on rounds, aureomycin infusion of whole carcasses was undertaken. Six whole carcasses were infused with aureomycin solution. The carcasses were then split; one side of beef was placed in the chill room, the other was held at room temperature. Bacteriological examination made of the muscle tissue and lymph nodes generally supported data obtained from the rounds.

Tenderness studies were carried out by taste panels at the end of five days. These determinations indicated that beef held in the chill room five days was less tender than beef held at room temperature for two days and then stored three days in the chill room. This was true in each of the six carcasses studied.

Assays were carried out on all samples of beef containing aureomycin, including ground beef, rounds, and whole carcasses. It was determined that at similar temperature and pH, aureomycin was less stable in beef than in saline solution. No aureomycin was detectable in beef which had been kept at room temperature for 48 hours and then refrigerated for three days.

Results of this investigation suggest a practicable method for improving beef quality and a possible aid in the handling and transporting of fresh beef.

104 pages. $2.00.

Abstract published by special arrangement with The Ohio State University.

STUDIES ON FACTORS INFLUENCING THE INTERACTION OF WESTERN EQUINE ENCEPHALOMYELITIS VIRUS AND SELECTED TISSUE CELLS

(L. C. Card No. Mic 58-1088)

Royce Zeno Lockart, Jr., Ph.D.
University of Washington, 1957

Employing the plaque count technique of Dulbecco, a quantitative study was made of various factors influencing the interaction of western equine encephalomyelitis virus (WEE) and L cells, a strain of mouse fibroblasts, and chick embryo tissues.

Inactivation rates of WEE virus at 37° C were determined in three complex growth media, which were used in the tissue culture systems under study. The virus proved relatively unstable showing a half-life of between two and one-half and four and three-quarter hours. Virus was found to be very unstable in phosphate-buffered saline (PBS), a commonly used suspending medium, with about 90 per cent inactivation occurring in one hour.

Between 40 and 99 per cent of the active WEE virus added to L cell monolayers adsorbed in one hour depending on conditions. More adsorption occurred if the plates were agitated during this time. There was no difference in the rate of adsorption at room temperature and 37° C or whether PBS or the medium used to grow L cells was used as the suspending medium, provided that the monolayers were washed with PBS prior to addition of virus.

A more critical evaluation of adsorption was carried out using chick embryo monolayers. Reduced plaque formation by WEE virus on chick embryo tissues occurred when the virus inoculum was suspended in media containing 0.22 per cent sodium bicarbonate rather than in PBS. Reduced plaque formation was chiefly the result of reduced adsorption. Increased pH in the bicarbonate buffered media accounted for some of the reduction but the

presence of bicarbonate, as such, was responsible for most of the observed decrease.

Single cycle growth curves of WEE virus were performed on both chick embryo and L cell monolayers. Virus was added in PBS and the excess free virus was removed after a one hour adsorption period. Between two and three hours after infection chick embryo tissues began to release new virus and a maximum titer was reached at about 12 hours. It was estimated that each cell released about 2500 plaque-forming units (pfu). L cell monolayers first released new virus between five and seven hours, and reached a maximum titer at about 30 hours at which time between 250 and 700 pfu were present in the fluid for each cell originally present. Complete destruction of cultures always ensued.

However, in many cases, monolayers of L cells were infected by adding virus directly to the medium in which the cells were growing. Complete degeneration of L cell monolayers was obtained in only two of 33 cultures when stock WEE virus produced in chick embryo tissues was added directly to the medium in which the cells were growing. In contrast, when PBS was used as a suspending medium for the virus, addition of about 6 to 10 pfu per cell regularly caused complete degeneration. These observations led to further considerations of the virus and its enviornment which might explain the lack of destruction in some cases.

WEE virus inactivated for about 100 hours at 37° C was capable of initiating interference in L cells. When monolayers treated with inactive virus were challenged with fully active virus, interference was manifest in a reduced amount of active virus production and in suppressed cytopathogenicity. A contact period of four hours between inactive virus and L cells initiated interference in one experiment, but generally 12 to 24 hours were necessary. Monolayers challenged 14 days after the addition of inactive virus still showed reduced virus production and suppressed cytopathogenicity.

Interference with virus production also occurred when chick embryo tissues were treated with inactive WEE virus and later challenged with active virus. Treatment of chick embryo monolayers for four hours with inactive virus reduced the number of plaques produced by subsequently added active virus. Those plaques which did appear were so small as to be barely visible. When titrating inactive virus preparations for residual active virus, an anomolous titration effect was observed; the plaques which were very small when undiluted inactive virus preparation was plated became progressively larger with dilution.

A number of observations support the viewpoint that interference is due to inactive virus particles. Inactive virus preincubated with specific antiserum lost much of its ability to produce interference in L cells or chick embryo tissues. Interfering ability could also be reduced by high speed centrifugation of an inactive preparation and could be almost completely recovered from the sedimented material. Interfering ability of inactive preparations was lost rapidly upon dilution to levels at which insufficient inactive virus was present to infect all the cells in a culture. No interference could be induced by media from uninfected chick embryo cells treated the same way as media from infected cultures.

The possible significance of (1) inactivation, (2) adsorption, (3) environment, (4) virus production, and (5) interference were discussed with respect to the observation of persistent virus production in the L cell-WEE virus system described by Chambers (15).

121 pages. $2.00.

THE PHYSIOLOGICAL BASIS FOR THE INACTIVITY OF CITRATE OXIDASE IN *ESCHERICHIA COLI* AND *BRUCELLA ABORTUS*

(L. C. Card No. Mic 58-1429)

Russell Earl MacDonald, Ph.D.
University of Michigan, 1957

The apparent inability of intact cells of *Brucella abortus* and *Escherichia coli* to oxidize citrate, whereas cell extracts do oxidize it, has been noted frequently and is representative of a general phenomenon of apparent enzyme latency *in situ*. The present study attempts to explain this anomaly.

The oxidative response of *B. abortus* to citrate under varying conditions was investigated by means of conventional manometric techniques. It was found that neither varying pH and concentration of citrate, addition of various energy sources, growth conditions or age of cells, addition or removal of metallic ions, use of citrate analogs, freezing, drying, nor treatment of cells with various solvents had any effect in enabling the cells to measurably increase their rate of oxygen uptake in the presence of citrate. However, cell extracts did contain an active citric oxidase and large masses of cells gave a measurable increase in the rate of oxidation of citrate. Furthermore, isocitric acid lactone appeared to be oxidized readily. It was concluded that citrate is degraded by intact *B. abortus*, although at a rate too low to be detected by ordinary methods in the presence of its normally high endogenous rate of respiration.

The oxidative response of *E. coli* to citrate was not altered by the addition of variously substituted esters of citric acid, nor by treatment of the cells with various solvents. However, cell rupture, drying, treatment with lysozyme, or heating for short periods at 100°C revealed an active citric oxidase in *E. coli*.

The penetration of citrate into *B. abortus* and *E. coli* was measured by a direct method which is based on the theory that large masses of cells will act as a diluent for any substrate which penetrates them and that the degree of penetration will be directly proportional to the dilution. Thus,

$$Scit = \frac{Vs}{Wc}\left(\frac{Co}{Cf} - 1\right) \times 100$$

where Scit = percentage of cell pack penetrated by citrate, Vs = volume of substrate, Wc = weight of packed cells, Co = initial concentration of substrate, and Cf = final concentration. The volume of the intercellular space was determined by a similar formulation using a non-penetrating substrate (inulin) and was substracted from Scit to give the corrected citrate space (R). Citrate was analyzed by a pentabrom acetone method and inulin, gravimetrically.

Thus it was calculated that citrate entered 41% of a *B. abortus* cell (in 10 min at pH 6.4 and 0°C) and 23% of an *E.*

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coli cell under the same conditions. The space in E. coli penetrated by citrate was not changed by the addition of glucose or isocitrate nor did it decrease with increased citrate concentration. The space is subject to variables of temperature (0° = 23%; 60° = 40%), pH (pH 9.0 = 15%; pH 3.0 = 70%), and ion concentration. In the absence of ions, the space penetrated was 12%, but this increased with ion concentration up to a maximum (40%) in 0.100 M sodium or potassium ions. Calcium or magnesium had a maximal effective concentration of 0.050 M. If present at a concentration over 0.0125 M, ferric ions caused complete disappearance of the added citrate. A small amount of calcium appeared to be essential for maximum penetration of citrate. Dried cells had 50% of their volume available to citrate. Treatment of cells with butanol, chloroform, or toluene similarly caused a marked increase in citrate space (up to 75%).

It was concluded that the inability of intact E. coli to oxidize exogenous citrate occurs either because of impermeable membranes interior to the cell surface, or because of a labile inhibitor of the oxidase within the cell.

171 pages. $2.25.

THE PRODUCTION BY BACILLUS THURINGIENSIS BERLINER OF A HEAT-STABLE SUBSTANCE TOXIC FOR INSECTS

(L. C. Card No. Mic 58-1129)

Ellicott McConnell, Ph.D.
University of Minnesota, 1957

Adviser: A. Glenn Richards

The pathogenicity of Bacillus thuringiensis Berliner for insects has been recognized since Berliner isolated the bacillus from larvae of the Mediterranean flour moth in 1915. Since that time a number of investigators have attempted to use the organism for the biological control of insect pests.

It has been recently established that the bacillus produces two proteinaceous substances toxic for insects, a lecithinase, and a crystalline inclusion body.

The present study presents evidence for the existence of a third toxic principle. This is a heat-stable, dialyzable substance which is water-soluble and resistant to low temperatures. It is probably neither a protein nor a lipid. The toxin was found to be present in larvae of the wax moth, Galleria mellonella, which had died from an infection of B. thuringiensis. Substances with similar properties were demonstrated in cultures of B. thuringiensis and Bacillus cereus Fr. and Fr. It is not known if the heat-stable toxins from larvae and from bacterial cultures are identical.

Supernatant from autoclaved and centrifuged broth cultures of B. thuringiensis was toxic for all of those species of insects into which the supernatant was injected, but was not toxic for insects when ingested. This is the opposite of results obtained by Canadian workers for the crystalline inclusion bodies. The LD 50 of a single lot of culture supernatant was found to be approximately the same for several species of insect. These tests included insects belonging to the orders Lepidoptera, Orthoptera, and Diptera.

The time of appearance of the toxin in liquid culture was determined relative to the growth characteristics of the bacillus. The toxin was found to appear prior to sporulation or the formation of the crystalline inclusion bodies.

Profuse sporulation occurred only in cultures which were well aerated on a mechanical shaker. No sporulation was observed in Galleria or corn borer larvae which were inoculated by ingestion of viable cultures of the bacillus. Neither was it possible to recover B. thuringiensis from such larvae after 48 hours post mortem.

50 pages. $2.00.

FURTHER STUDIES ON A NONSPECIFIC BOVINE SERUM AGGLUTININ

(L. C. Card No. Mic 58-1147)

Thomas George White, Ph.D.
University of Minnesota, 1957

Nonspecific Brucella agglutinin (NSBA) is a component of bovine serum which agglutinates Brucella antigen as well as many other bacterins. The material appears to be ubiquitous; however, it reaches circulating blood serum levels which are readily detectable only in a small per cent of normal animals. Its presence has never been associated with any known disease process.

The material itself is a pure protein with a sedimentation constant of 14 to 19 Svedberg units (S), placing it in the group of proteins with molecular weights near 1,000,000.

The national program for the eradication of bovine brucellosis is impaired by the false positive agglutination reactions caused by the serum from animals which produce this protein.

Extensive bacteriological, clinical and epidemiological examinations of 24 cows showed no evidence of infection with Brucellae. A differential test, the acidified plate antigen test, is thus recommended as a means of distinguishing infected animals from those producing NSBA; hence, allowing owners to retain such animals within the herd without risk of leaving infection in the herd is justified.

Amino acid and ultracentrifuge analyses of purified preparations of NSBA revealed it to be a unique serum protein. NSBA is not a disulfide linked polymer of any other serum component.

Nonspecific Brucella agglutinin is not identical with properdin as measured by its activity with zymosan.

On the basis of quantitative tube agglutination tests, two types of NSBA are shown to exist as the result of heat inactivation. Half-life determinations showed a significant difference between the two types at various temperatures. Two sources of serum from animals representing chronic and new infections with Brucella also showed a significant difference in half-life determinations.

Specific agglutinins are more readily absorbed than is NSBA when a mixture of the two agglutinins is exposed simultaneously to Brucella antigen. When exposed to the antigen independently, a unit surface of Brucella antigen lowers the titer of NSBA more than specific agglutinins. It is postulated that chemically different and independent sites of attachment are involved with the two types of agglutinin.

76 pages. $2.00.

CATHARINE MACAULAY: EIGHTEENTH-CENTURY REBEL. A SKETCH OF HER LIFE AND SOME REFLECTIONS ON HER PLACE AMONG THE HISTORIANS AND POLITICAL REFORMERS OF HER TIME.

(L. C. Card No. Mic 58-755)

Mildred Chaffee Beckwith, Ph.D.
The Ohio State University, 1953

It is a perversity of fortune that Catharine Sawbridge Macaulay, whose chief interest lay in the extension of democracy, should have lived in a century when her sex was denied active citizenship. Long before America set a new pattern in political freedom or France immortalized its watchwords liberté, egalité, fraternité, she had pointed out the dangers of royal absolutism and was ardently pleading the cause of liberty. Her interest in history and her taste for politics could be satisfied only through her pen, but it brought her fame and the descriptive title "celebrated female historian." Contemporaries were amazed by her "masculine mind"; they were shocked when she protested respectable eighteenth-century political practices. Although they criticized her viciously when circumstances in her personal life afforded the opportunity, they also had a curious interest in her unconventional career. Mrs. Macaulay achieved the distinction of being her country's first woman historian, played a signal role in her century's demand for political reform, and proved to be an inspiration to other women of her century whose names now are better known than her own.

Catharine Sawbridge was born in the county of Kent in 1731 into a gentry family which had extensive London interests. Her education, largely self-acquired, included a study of history and government, which were not then considered proper subjects for girls but which were the natural bent of her mind. Eventually they meant more to her than an academic interest, for through them she acquired an admiration for republican government which became the passion of her life. Her marriage in 1760 to Dr. George Macaulay, a London physician, established her in an intellectual atmosphere which kindled her wit and gave her the sympathetic understanding which matured her thinking and inspired her to write. Three years later the first volume of her magnum opus, The History of England from the Accession of James I to the Elevation of the Brunswick Line, was published, and by 1771 she had completed four more volumes of that work. Meanwhile, a daughter was born; also, Dr. Macaulay had died. The year following her husband's death her first political pamphlet came from the press, criticizing absolute monarchy and praising republican government; a second one in 1770 advocated practical reform of the English parliament. These unorthodox political views showed Mrs. Macaulay to be a radical in political thought, automatically placing her in the spotlight of public opinion. Being uttered by a woman, men found them more amazing than challenging, and subsequent criticism more frequently was based on the impropriety of her having engaged her thought in these subjects than on the merits of her writing. Her London salon, then at its height, became a forum for liberal political ideas, in sharp contrast to the Assemblies of the better known English bluestockings who frowned upon the discussion of politics as well as on Mrs. Macaulay's unconventional role.

In 1774 she went to fashionable Bath to reside. About two years later, she and her daughter accepted the invitation of the elderly Dr. Thomas Wilson, formerly a chaplain at the court of George II and now a political liberal, to share his elegant home. The dubious honors he showered upon her opened the way for personal criticism which became rampant following her second marriage. During this period Mrs. Macaulay began a new historical series, The History of England from the Revolution to the Present Time, a poorly received work, and two pamphlets: a plea for the rights of authors to copyright, and a defense of the American cause. She remained in Bath until her marriage to William Graham (1778) which brought virulent criticism because of the disparity of their ages and social standing, and she then left the city permanently.

Five years later Mrs. Macaulay Graham had completed the last three volumes of her history of the Stuarts. She and her husband then sailed for the new world to spend approximately a year in America, principally in Boston where she had formed political friendships, one of which, with Mercy Warren, sister of James Otis, developed into a close relationship. Before returning to Europe they visited acquaintances in Portsmouth, New York, Philadelphia, and Baltimore, as well as the Washingtons at Mount Vernon. Upon leaving America they sailed for France, hoping its mild climate would restore Mrs. Macaulay Graham's failing health, but within the year they returned to England, eventually taking up residence at Binfield, near London, on the edge of Windsor Forest. Here she wrote her last book, Letters on Education, and one pamphlet, a defense of the French Revolution, neither of which attracted much attention. Her republican writing was no longer a novelty, and she had long since faded from the public conscience. Mrs. Macaulay Graham died at Binfield in 1791, where a tablet to her memory was placed in the local church by her husband.

In a period of exactly fifteen years Mrs. Macaulay rose from the status of an unknown author to the pinnacle of fame, fell from high acclaim, and suffered the rebuff of unfavorable public sentiment. Newspaper and magazine comment on both her writing and personal affairs, likewise the sentiment of those who portrayed her in verse and the graphic arts, followed this same pattern in their reactions. But the remarks of persons of literary fame, notably James Boswell, Samuel Johnson, and Horace Walpole, did not conform to this design; their observations more often depended upon the individual's attitude toward her political principles, although at times, they, also, criticized aspects of her personal life. Mrs. Macaulay's literary reputation in England had reached its lowest ebb

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on the eve of her second marriage, and satire then turned to personal abuse. In contrast, Americans praised her love of liberty and were more charitable toward her indiscretions. Outwardly she did not flinch under sharp criticism, but she did state that she felt literary criticism should be completely divorced from personal considerations.

But unfavorable criticism failed to persuade Mrs. Macaulay to give up her ideas on social, educational, and political reform. Among the social reforms which she urged were a restriction on granting hereditary titles, erasure of primogeniture by equal division of land among male heirs, and more humane treatment of prisoners. Although she strongly favored democratic political reforms, she did not advocate social equality. In the field of educational reform she contended that English education was inadequate for both men and women, particularly resented the eighteenth-century belief that woman's intellect is inferior and urged coeducational study. However, she did not advocate the establishment of public schools. In the education of men on the university level, she recommended that more attention be given to history and the Constitution as a means of increasing appreciation for democracy and realizing the need for political reforms.

The demand for political reform in England was first obvious in the decade of the 1760's, when George III set out to exercise the prerogative which his immediate ancestors had lost to ministerial government. Mrs. Macaulay was one of a small group which advocated specific changes, although it was virtually the end of the decade before there was an opportunity for her to speak out in support of them. Meanwhile, her dislike for absolutism and her admiration for democratic government, intensified through her study and writing on the Stuart period, led her to venture into the realm of political theory. A faithful disciple of John Locke, her one pamphlet dealing with political theory was written largely in criticism of Thomas Hobbes' praise for absolute monarchy, but it also included a brief plan for a republic, thus appearing to express the negative and positive sides of her thinking.

Mrs. Macaulay's interest in political theory soon gave way to a stronger interest in practical political reform. The formation of "The Society for the Support of the Bill of Rights," a direct outgrowth of the struggle of John Wilkes for his claim to a seat in parliament, seems to have been the point at which Mrs. Macaulay turned to practical political reform. At virtually the same time Edmund Burke, genuinely concerned over George III's effort to substitute personal government for party control in the House of Commons, wrote a pamphlet against the King's policy, affording Mrs. Macaulay the opportunity to attack directly the evils of the English government. Her Observations on a Pamphlet Entitled the Cause of the Present Discontents was not only a reply to Burke; it also served to restate the demands of the early Radicals. She, like Burke, believed the King's policy to be detrimental, but she did not consider the proper solution to be a return to party government and strongly criticized both the unsavory condition of elections and the operation of parliament through party control of the Ministry. Five years later she extended her campaign for reform in another pamphlet, this time a challenge for more just treatment of the American colonies lest "tyranny" over them help to extinguish the rights of Englishmen at home. These pamphlets, together with one written in the closing months of her life on the French Revolution, comprise her direct attack on corruption in the English government.

The political reforms for which Mrs. Macaulay pleaded were the extension of suffrage, a more honest and equitable plan of representation, and the shortening of parliaments. Of these she gave the least attention to the question of suffrage, but believed that it should be extended gradually on the basis of education. She did not draw up a specific plan, but it appears that she would have granted suffrage to virtually all except paupers, basing it on the value of labor instead of a property requirement. On the question of representation she opposed rotten and pocket boroughs, agreed with the American attitude that a representative is a deputy of his district, and advocated that each Member be required to pledge that he would follow the advice of his constituency. Septennial parliaments were the greatest political evil, she maintained, because such a long term gave Members greater opportunity to enrich themselves, thereby increasing the cost of obtaining a seat. She recommended triennial parliaments, but if that change did not successfully combat the evils, then sessions should become annual. It may be that Mrs. Macaulay was the originator of the demand by "The Society for the Protection of the Bill of Rights" for annual parliaments; she had strongly advised an annual rotation in her plan for a political utopia published two years before the Society was formed, and her brother, John Sawbridge, was a charter member of that organization.

Colonial patriots eagerly embraced Mrs. Macaulay's political friendships, among them at least six signers of the Declaration of Independence. In American affairs she denounced parliamentary action from the Stamp Act through the Boston Port Bill and called for the repeal of laws which carried out the ill-fated British policy. Her argument of unconstitutionality held that the rights of Americans as Englishmen had been transmitted through their charters and the Constitution, centering her criticism on the fact that Americans were taxed but unrepresented. However, she did not suggest that they be directly represented in the English parliament. Neither did she directly advocate nor condone open revolution, but it must be concluded that she believed such action within their rights since she consistently supported Locke's compact theory.

Now that republicanism has become a conservative ideology, it is difficult to understand the shock of Mrs. Macaulay's political views on eighteenth-century minds. Perhaps the frequent characterization of her as a "red" republican has been an effort to expose the radical force of her ideas upon her contemporaries; it may also be intended to indicate that she was an active revolutionist. But there is almost no evidence that she would have supported violent revolution in England except against the encroachments of royal absolutism. Her writings seem to show that a democratic monarchy, comparable to that of twentieth-century England, would have been acceptable to her.

Admiration for the ancient republics caused Mrs. Macaulay to write history for what she termed the cause of "Liberty," by which she apparently meant a thoroughly democratic government. The Stuart period served admirably to illustrate her enthusiasm for Liberty's progress as well as her despair in its regression, for she believed that Stuart absolutism had irritated the nation into rescuing its lost liberty only to have it snatched by Cromwell before it had scarcely been regained. Imbued with a

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spirit of mission, she asserted that her motive in writing was to do justice to the men who challenged the Stuart claim to more extensive prerogative, and to those who supported the short-lived Commonwealth. At the same time there can be no doubt that she wrote to counteract David Hume's history of the same period which gave a favorable interpretation. Her strongest prejudices were those which caused her to look upon the seventeenth-century Republicans and Commonwealth as virtually flawless. Throughout the Stuart period she consistently regarded parliament as the only bulwark of freedom, but no parliament received such high praise as the initial one of the Commonwealth. Individuals were judged on their personal motives and their attitude toward public service. Although Mrs. Macaulay used a wide variety of sources, she was often blind to the virtues of men whose principles she opposed and to the faults of those whom she admired; consequently her broad coverage of materials is more commendable than her interpretation of men's characters based upon them. Charles I, depicted as deceitful and thoroughly unprincipled, is considered the most objectionable of the Stuarts. But she admired Cromwell even less, holding him entirely responsible for the death of England's "Infant republic" and giving no recognition to his knowledge of practical politics.

Mrs. Macaulay's works enjoyed a gratifying sale in the early period of her writing before the virulent criticism of her personal affairs. Their popularity had not revived when the radicalism of the French Revolution frightened all Europe. By the time the fright of the ideals of her history subsided, the complete objectivity of the von Ranke school of the nineteenth-century made it unacceptable as a standard work. Moreover, since she failed to apply to her writing the whole culture of her age, her work lacks the depth which her outstanding contemporaries achieved. They assessed broad values in terms of ideas, using the chronology of events only as a guide; their writings reflected the advantages of broad cultural study. Mrs. Macaulay depended wholly upon chronology, failing to weed out irrelevant details. Under the disadvantage of a limited education, her judgment and perspective were clouded by her political ideal. The writings of her contemporaries, although prejudiced, may still be enjoyed for the values inherent in good literature; Mrs. Macaulay's, although not poorly written, does not have the characteristics of living literature.

But it must be acknowledged, in spite of the faults of her historiography, that a woman who successfully broke the barriers of a field of study formerly untrod by her sex can not be cast aside without proper credit. Actually, her chief interest lay in political reform, although heretofore it has been looked upon as secondary to her authorship of an historic work. Her further significance lies in her influence upon other women who achieved prominence: Mercy Warren, whom she inspired to write a history of the American Revolution; Mary Wollstonecraft, renowned parent of the Woman's Rights Movement, who felt that she owed Mrs. Macaulay a moral debt; Mme. Roland, who stated, while in prison awaiting execution, that had she been permitted to live she would have aspired to become "la Macaulay de mon pays." Unfortunately Mrs. Macaulay's influential contemporaries did not credit her with devotion to a worthy cause, while the public, which did not have the desire or experience to understand her political ideas, relished the unflattering gossip which plagued her reputation. The best that can be said of her history of the Stuarts as an historical work is that it is a serious study by a resolute woman, written with honest conviction. But more important, it reveals her real passion to have been the regeneration of liberty and her historical writing an avenue to that utopia. Candor and justice should take precedence over the taint of indiscretions and "red" republicanism of the eighteenth-century rebel, the first woman to enter a field of learning reserved for masculine minds.

The present work on Mrs. Macaulay is based largely upon her writings, her letters in manuscript, and the letters and memoirs of her contemporaries. It can not be considered definitive, although it is the most extensive study made of her to date. More of her letters and other primary sources would be required to achieve such a study. Additional material would be particularly useful for a psychological interpretation of her personal life which seems to be indicated but which could not be done with validity now. Precisely where other sources may be found cannot be stated with certainty. 297 pages. $3.85.

Abstract published by special arrangement with The Ohio State University.

THOMAS CLAP, FIRST PRESIDENT OF YALE COLLEGE: A BIOGRAPHY

(L. C. Card No. Mic 58-1098)

Louis Leonard Tucker, Ph.D.
University of Washington, 1957

Thomas Stephen Clap, who was to become the third elected rector and first president of Yale College, was born in Scituate, Massachusetts, in 1703. Of unmixed Puritan ancestry, Clap travelled the well-marked Puritan path to the ministry. After receiving a grammar school education and advanced instruction from his minister, Clap enrolled in Harvard College and, ultimately, received his A.B. (1722) and A.M. (1725) degrees. In 1726, the twenty-three year old Puritan settled in the Congregational ministry in Windham, Connecticut.

For the next thirteen years Clap methodically carried out his functions as a minister, in the course of which he established a reputation as a severe disciplinarian, as a capable clerical scholar and natural philosopher (scientist), and as an unyielding exponent of traditional Puritan religious dogma. With his participation in a celebrated religious controversy in 1735 (Breck Case) Clap achieved considerable notoriety and became the focus of public, as well as clerical, attention in New England. Two years later, the Yale Trustees tapped him for the rectorship of the college. Clap's appointment signalized the beginning of a new epoch in the institutional history of the then-floundering New Haven school.

Clap virtually reconstituted Yale College in the period of his rectorship and presidency (1740-1766), which began some fifteen years before the French and Indian War and extended through the Stamp Act crisis. In this quarter of a century, Yale College, under Clap's dynamic, forceful, oftentimes despotic, leadership rose from relative obscurity to challenge Harvard's position as the leading institution of higher learning in colonial America. On all

levels of administration the New Haven school felt Clap's unique powers of organization, his love or order and system, his tenacity in purpose, his thoroughness in detail and his boundless energy and industriousness. He was singularly responsible for a host of reforms. These reforms were all-embracing and included, in part: the reorganization and enlargement of the library; the compilation of a comprehensive prescriptive code; the construction of physical facilities; the enlargement of the teaching staff; the amassing of scientific equipment; the expansion and liberalization of the curriculum; and, most importantly, the adoption of a new charter by which the college government was organized in the form of a corporation under the direction of a President and a Board of Fellows. Clap's administration was without question the most decisively constructive period in the early history of Yale College.

Marked though it was by a significant advance in the development of the college, Clap's reign was nevertheless a turbulent era in Yale's history. Violent resentment was awakened against Clap because of his narrow, Calvinist-based, theological convictions, his harsh and high-handed discipline and his illiberal religious policies. The latter portion of his presidency, beginning with his establishment of a chair of divinity in 1755, was pervaded with political and religious controversies and almost continuous student disorder. Clap was bitterly attacked by a group of prominent Connecticut political and clerical figures, by some members of the Yale Corporation and by the Yale student body, all of whom agitated for his removal. The strife and dissension persisted for over a decade, increasing yearly, until finally, in 1766, conditions became so chaotic that Clap was compelled to tender his resignation. In the last analysis it was the Yale student body that drove Clap into resignation, the students having made it patently clear that they would no longer submit to his authority.

Four months after conducting his final commencement ceremony, the repudiated educator fell ill with a respiratory ailment and shortly thereafter died. He was buried in the Grove Street Cemetery. 464 pages. $5.90.

BIOLOGY — GENETICS

VALINE BIOSYNTHESIS IN NEUROSPORA

(L. C. Card No. Mic 58-1291)

George Andrew Harmon, Jr., Ph.D.
Stanford University, 1958

An acetateless mutant strain of Neurospora crassa, Y2492, was grown on acetate-1-C^{14} and acetate-2-C^{14} in separate cultures. The mycelial pads from each culture were harvested and the carbohydrates and lipids were extracted. The mycelial residues were then hydrolysed and the amino acids separated by chromatographic methods. The amino acids valine, alanine and glycine were isolated after the addition of appropriate amounts of carrier amino acid. These amino acids were degraded and an isotopic analysis of each carbon atom was made.

TABLE I

SUMMARY OF C^{14} ACTIVITY FROM "METHYL LABELED" ACETATE SUBSTRATE

	Valine		Alanine		Glycine	
Carbon atom	CH_3 CH_3 CH-$CHNH_2$-COOH		CH_3-$CHNH_2$-COOH		CH_2NH_2-COOH	
	Per cent	S.A.*	Per cent	S.A.*	Per cent	S.A.*
Total	100	16.0	100	8.45	100	3.68
COOH	12.5	2.0	25.3	2.14	47.8	1.76
2	23.8	3.81	39.1	3.3	52.2	1.92
3	16.5	2.64	35.5	3.0		
4 or 4'	23.9	3.82				

*Specific activities of the amino acids as isolated from the mycelium expressed as disintegrations per minute per 0.1 millimole X 10^6.

TABLE II

SUMMARY OF C^{14} ACTIVITY FROM "CARBOXYL LABELED" ACETATE SUBSTRATE

	Valine		Alanine		Glycine	
Carbon atom	CH_3 CH_3 CH-$CHNH_2$-COOH		CH_3-$CHNH_2$-COOH		CH_2NH_2-COOH	
	Per cent	S.A.*	Per cent	S.A.*	Per cent	S.A.*
Total	100	2.92	100	4.27	100	5,61
COOH	102	2.98	93.8	4.03	100	5.6
Non-carboxyl	4.3	.12	6.2	.24	0	- -

*Specific activities of the amino acids as isolated from the mycelium expressed as disintegrations per minute per 0.1 millimole X 10^6.

The C^{14} activities obtained for the individual carbon atoms of valine and alanine suggest that in Neurospora these amino acids are derived from pyruvate. From the isotopic data it is not possible to distinguish between ribose and serine as the source of the glycine carbon skeleton. Carbon dioxide fixation appears to contribute significantly to the labeling of the carboxyl groups of these amino acids. 52 pages. $2.00.

LINKAGE STUDIES WITH CHROMOSOMAL TRANSLOCATION STOCKS IN BARLEY

(L. C. Card No. Mic 58-1125)

Ronald Wilson Livers, Ph.D.
University of Minnesota, 1957

Adviser: C. R. Burnham

This thesis is concerned primarily with linkage studies between six different reciprocal translocation stocks in barley and marker genes of the seven barley linkage groups. The main purpose of the study was to assist in clarifying chromosome and linkage group relationships in the species.

Linkages observed between translocations and genetic markers are as follows: the b-d translocation C1358 and the gene n in linkage group III showed 19.28% recombination ± 2.85%; C1385 (a-b) and a_{c2} in group III, 7.57 ± 1.42%; C1420 (e-f) and gene e in group I, 11.26 ± 2.27%; C1432 (c-e) and a_c in group VI, 3.06 ± 1.40%; C1432 (c-e) and x_c in group VI, 3.90 ± 1.21%; C1432 (c-e) and a_n in group VI, 6.42 ± 1.99%; C1432 (c-e) and Bt, one of two complementary dominant genes conditioning brittle rachis, were very closely associated; C1456 (a-e) and gl_2 in group IV, 3.90 ± 0.87%; and C1483 (b-g) was linked with n in group III with 16.08% recombination ± 2.03%.

The above information was integrated with gene-translocation linkage data from several other studies. Conclusions based on all the linkage information involving the eight translocations being considered in this study are as follows: Linkage group I is on chromosome f or on e with group IV, group II is on chromosome a or on e with group IV; Group III is on b; group IV is on e; group V is on d or on b with group III; group VI is on c; and group VII is probably on chromosome b with group III. These conclusions are all in accord with recent independent evidence obtained by Tsuchiya with barley trisomics. The trisomics have, in addition, shown conclusively that linkage groups I and II are independent of group IV; that group V is independent of group III; and that groups III and VII are definitely on the same chromosome.

The glossy gene gl_2 of linkage group IV was shown to be very close to the break point of a-e translocation C1456 (3.9% recombination). Previous studies had located this break point in group IV about midway between genes K and Bl. Combining these observations serves to locate gl_2 in group IV at approximately the midpoint between K and Bl.

It has been noted earlier that Bt showed strong association with the c-e, (VI - IV), translocation C1432. In other crosses not involving this translocation, Bt showed linkage with a_c and x_c in group VI; but not with gene K in group IV. It is concluded that at least one of the two Bt genes conditioning brittle rachis in the cross of Mars x Colsess is located in linkage group VI. Colsess carries the Bt gene that is in group VI and Mars carries the other dominant gene.

A new character termed multiflorous with variable expressivity was described. A ratio of 9 multiflorous to 7 normal appears to fit the data. None of the following showed any association with the character: C1358; C1405; or genes R, S, T or y_c.

The mode of inheritance of the post-harvest dormancy of Colsess could not be determined from the data obtained. However, dormancy showed association with the b-g translocation C1483; and also with the S gene of linkage group V.

In addition to the linkage information indicated, some cytological observations were obtained. Cytology on F_1 plants of intercrosses between translocation tester stocks of known chromosome constitution and unknown translocation stocks C1478 and C1483 revealed that these translocations involve chromosomes b-d and b-g respectively.

69 pages. $2.00.

GENE HOMOLOGIES IN COLUMBIDAE

(L. C. Card No. Mic 58-832)

Jack Herman Stimpfling, Ph.D.
The University of Wisconsin, 1958

Supervisor: Professor M. R. Irwin

Backcross hybrids have been obtained by mating to Streptopelia risoria the species hybrids and selected backcross hybrids from matings of S. chinensis, S. humilis, S. orientalis and S. senegalensis to S. risoria. Similarly, backcross hybrids have been obtained by mating to Columba livia the species hybrids and selected backcross hybrids from matings of C. guinea and C. livia. The cellular antigens of the erythrocytes which distinguish chinensis, humilis, orientalis and senegalensis from risoria, and guinea from livia, are determined by single genes, or by two or more genes which to date have not separated. The interrelationships of the following antigenic characters of the blood cells, particular to the respective species, are considered: d-1 of chinensis, hu-1 of humilis, or-1 of orientalis, s-1 of senegalensis and E of guinea. The reagents made from antisera produced in rabbits by immunization with the cells carrying any one of these five cellular antigens are reactive with the homologous cells; they cross-react, also, with the other four antigens, thus indicating serological similarity of these antigenic characters.

A cellular antigen of risoria, designated ri-1, has been demonstrated to be antithetically related to d-1, or-1, s-1 and probably to hu-1. Consequently, d-1, hu-1, or-1 and s-1 appear to be contrasting cellular antigens. Because of the genetic and serologic affinities shared by d-1, hu-1, or-1 and s-1, they are collectively designated as the group-1 cellular antigens. Although it has been demonstrated that ri-1 is antithetical to d-1, or-1, s-1 and probably to hu-1, it has not, because of technical difficulties, been established whether ri-1 shares serological properties with the group-1 antigens. The inclusion of E in the group-1 system is based only on its serological relationship to other members of group-1.

In addition to the five species from which the respective group-1 antigens were derived, nine other species belonging to Columbidae have been found to possess cellular antigens related to group-1. Since it has been shown that the group-1 antigens of at least four species are genetically related as contrasting characters, it is presumed that the group-1 cellular antigens found on the cells of other species are related in the same manner.

Appropriate serological methods have indicated that the group-1 antigen which characterizes the blood cells of a particular species has a number of antigenic substituents, i. e., antigenic specificities. These respective specificities may be shared with some species to the exclusion of

others. Further, a particular species may possess one or more specificities not detectable on the cells of other species. In terms of antigenic specificities, which are shared among the species tested, the serological interrelationships of the group-1 cellular antigens are very complex.

The investigation has shown that variations of the group-1 antigen may occur on the cells of individuals belonging to a single species. For example, representatives of humilis may be placed in one or another of three categories with regard to the serological properties of their respective group-1 antigens: one category is serologically indistinguishable from hu-1 and the group-1 antigen of S. dussumieri; another category is closely related to, but not identical with s-1; a third category is closely related to one of the two categories of the group-1 antigen identified as being peculiar to orientalis.

It is presumed that in each of the species possessing group-1 specificities, the genes which determine the group-1 cellular antigens are related by virtue of their evolution from a common ancestor. The interrelationships of group-1 antigens in the various species tested provide an example of the manner in which a gene, or two or more linked genes, have undergone modification in the evolution of a related group of species. 134 pages. $2.00.

DIFFERENTIAL BEHAVIOR OF WHEAT CHROMOSOMES IN MONOSOMICS: THEIR TRANSMISSION AND RADIOSENSITIVITY

(L. C. Card No. Mic 58-1269)

Koichiro Tsunewaki, Ph.D.
Kansas State College, 1958

Experimental results on radiological study of monosomics of Triticum aestivum var. Chinese Spring were reported.

Gene evolution is one of major topics in genetics. Comparative study of homologous chromosomes in polyploids is an approach to this problem. Radiological study of monosomics provides an efficient way to study individual chromosomes, through which analysis of homologous chromosomes becomes possible.

The experiments were conducted in three mutually correlated parts. First, frequency of monosomics was estimated for all chromosomes. Secondly, radiological sensitivities of the disomic and Monosomic-10 were comparatively studied with wide range of X-ray. And, in third, comparative study of radiosensitivities of 16 monosomics and disomics was worked out with a specific X-dose.

Chromosome number was determined in root-tip cells with Feulgen's smear method. X-ray treatments were conducted on dormant seeds. Differential radiosensitivity was defined with interaction between genetic materials and X-doses. Radiosensitivity of monosomics was estimated from X-ray damages on disomics and mixture of the monosomic and its frequency.

Cytological investigation revealed that monosomic frequency is significantly different among progenies of all monosomics. The frequency of monosomics in selfed progenies is highest for Monosomic-3 with 89.2 per cent and lowest for Monosomic-20 with 52.2 per cent. Correlation studies of this monosomic frequency with frequency of pollen tetrads with micronuclei and frequency of chromosome-deficient gametes indicated that differential selection and competition among various gametes are important in determining transmission rate of monosomic condition. Deficient gametes of Chromosome-3 and -17 seem to be more preferable and those of Chromosome-20 and -4 are more disadvantageous than average group of chromosome-deficient gametes.

X-ray effects were classified into reversible and irreversible ones. Concerning the irreversible effect of X-rays, Monosomic-10 was much more sensitive than the disomic throughout all developmental stages. The reversible effect of X-rays is differential on Monosomic-10 at first and second stages. However, differential sensitivity of Monosomic-10 is not detectable in later developmental stages.

Several morphological mutations were observed in X_1 plants. Speltoid and awned mutants were the most common. Frequency of speltoid mutants, to which Chromosome-9 is responsible, was same in disomics and in Monosomic-10. On the other hand, mutation rate of awnedness, that is recessive in nature, was four times higher in Monosomic-10 than in the disomic. Chromosome-10 is known to carry a factor responsible for awn expression. It was theoretically predicted that apparent mutation rate of a gene on a specific chromosome must be much higher in corresponding monosomics than in disomics, when the mutation is recessive. The experimental result supported it. Radiological study of monosomics may be a helpful way to screen mutants with identification of responsible chromosome.

Radiological responses of 16 monosomics and disomics to a moderate X-dose were studied through three developmental stages. Differential sensitivity was significant through all stages studied. However, analysis of X-ray response of individual chromosomes showed that radiosensitivity of monosomics completely depends upon developmental stages. Monosomic-13 is sensitive but Monosomic-2 resistant in germination. Monosomic-3, -10, -15 and -16 are sensitive and disomics resistant in first leaf stage. Monosomic-8, -15 and -19 are sensitive but Monosomic-4 and disomics are resistant at tillering stage. These facts suggest that corresponding chromosomes have a specific role in each developmental stage. If it is so, radiological study of monosomics may be a new approach in developmental genetics.

Some chromosomes, which belong to the same homoeologous group, show some common pattern of X-ray response. Monosomic-2 and -13 of homoeologous group-2 show extreme responses in germination; Monosomic-3 and -16 of homoeologous group-3 are remarkably sensitive in the first leaf stage; and Monosomic-4, -8 and -15 of homoeologous group-4 respond extremely in the tillering stage. Such coincidences might have some significance on evolution of these chromosomes.

127 pages. $2.00.

The items following each abstract are: the number of manuscript pages in the dissertation, its cost on microfilm, and the Library of Congress card number. Enlargements 5-1/2 x 8-1/2 inches, 4 cents per page. No postage is charged if check or money order accompanies order.

AN OLIGOCENE FLORA FROM THE RUBY RIVER BASIN IN SOUTHWESTERN MONTANA

(L. C. Card No. Mic 58-880)

Herman Frederick Becker, Ph.D.
University of Michigan, 1957

A flora from Tertiary fossiliferous shales of the upper Ruby Basin in southwestern Montana is described. The intermontane lacustrine deposits consist of two lithofacies, a lower, blocky shale member, and an upper, thinly laminated member of paper shales. Each lithotope contains a distinct, but related florule, collectively comprising aquatic, riparian, temperate forest, xeric woodland, and desert scrub associations.

Collections of carbonized plant remains made at intervals between 1947 and 1955 reveal a flora consisting of twenty-nine families and sixty-four identifiable species; fourteen of the latter are heretofore undescribed. Twenty additional species are not specifically determinable, and are therefore assigned generic rank only. Two-thirds of the species are angiosperms and one-third are gymnosperms. Arcto-Tertiary and Madro-Tertiary elements are equally represented. Significantly, a 42 percent specific identity between the Ruby and Florissant floras exists. Comparison of the Bridge Creek and Green River floras with the Ruby assemblage reveals an 8 percent specific overlap. The strongest bond between the Ruby and Florissant floras is evidenced by Cotinus fraterna, Fagopsis longifolia, Mahonia obliqua, and Populus crassa, four species hitherto unique to the Florissant locality until their discovery in the Ruby shales. Nearly identical floristic units suggest that the latter two fossil sites were part of a single botanical province.

The diverse ecological affinity of the Ruby shales permits reconstruction of paleoecological communities. Some ecological units are ecotones indicative of abrupt topographic changes accompanied by considerable variations in temperature and humidity. The variety of fossil deciduous species indicates greater precipitation and warmer temperatures than exist in the Ruby Basin today.

Historical significance is attached to the recognition of migration of larger continental floras and their components that resulted in adaptation to suitable climatic zones, extinction or retreat to Asia. Physiographically the Tertiary Ruby Basin and surrounding mountains presented a situation not much different from the present. Increased aridity accentuated the xeric character, a fact which is reflected in the Ruby Basin today.

The Ruby shales are of late Oligocene age, and nearly contemporaneous with the Bridge Creek, but younger than those of Florissant. The Recent flora is chiefly xeric-semidesert, xeric-coniferous, and Hudsonian-deciduous and coniferous. 218 pages. $2.85.

A STUDY OF THE EFFECT OF LIGHT ON THE ACCUMULATION OF ASCORBIC ACID IN GREEN PLANTS

(L. C. Card No. Mic 58-894)

Robert Leo Costello, Ph.D.
University of Michigan, 1957

The purpose of the present investigation has been to study the effect of light upon the accumulation of ascorbic acid in green plants. The problem has received considerable attention from other investigators, but because of the difficulty in distinguishing between an indirect effect of light through photosynthesis and a direct photocatalytic effect a definitive role for light in the biosynthesis of ascorbic acid has not been determined.

Using Lupinus albus L. as a test plant the sites of synthesis of ascorbic acid during the sequential stages of development of the seedling were ascertained. The various organs of the seedlings of this plant were then aseptically cultured in mineral solutions containing naturally occurring sugars to determine which of the organs could be most successfully employed in the investigation of the effect of light upon the accumulation of this vitamin. The organs were cultured on an agar medium, in liquid stationary or liquid shake culture. As a result of the findings in these preliminary experiments, epicotyls were chosen as the test material to be grown in shake culture in mineral solutions containing sucrose. The epicotyls were grown in light and darkness in the presence and absence of carbon dioxide. Further experiments were conducted with albino strains of Zea mays L. and Helianthus annuus L. grown intact, in soil.

It was found that when epicotyls were cultured on an agar medium containing sucrose they showed an increased ascorbic acid content in response to increased light intensities, whereas those grown submerged in liquid shake culture did not exhibit a response of the same magnitude.

The ascorbic acid content of lupine epicotyls grown in light was not affected by the presence or absence of carbon dioxide.

When intact corn plants of different pigmentation were grown under different light intensities or in total darkness, only those plants containing chlorophyll showed an increased ascorbic acid content in response to increased light intensity. It was also noted that lutea corn plants have a higher carotenoid and ascorbic acid content than albino corn plants. However, experiments with albino sunflower seedlings, known to be free of carotenoids, demonstrated that the presence of carotenoids is not essential to the synthesis of ascorbic acid.

It is concluded that light affects the synthesis of ascorbic acid in green plants indirectly through its effect on photosynthesis. There is no evidence from these experiments for the existence of a photocatalytic reaction in the biosynthesis of ascorbic acid. 119 pages. $2.00.

The items following each abstract are: the number of manuscript pages in the dissertation, its cost on microfilm, and the Library of Congress card number. Enlargements 5-1/2 x 8-1/2 inches, 4 cents per page. No postage is charged if check or money order accompanies order.

GROUND VEGETATION PATTERNS OF THE SPRUCE-FIR AREA OF THE GREAT SMOKY MOUNTAINS NATIONAL PARK

(L. C. Card No. Mic 58-1320)

Dorothy Louise Crandall, Ph.D.
University of Tennessee, 1957

Major Professor: Royal E. Shanks

Forest-site types and various interrelationships of the upper and lower strata of the spruce-fir forests in the Great Smoky Mountains National Park are discussed. Based upon frequency and coverage of species of shrubs and herbaceous plants, the eight site types proposed for the southern boreal forest are as follows:

1. Oxalis-Hylocomium
2. Oxalis-Dryopteris
3. Hylocomium-Vaccinium
4. Viburnum-Vaccinium-Dryopteris
5. Senecio
6. Viburnum-Vaccinium-Senecio
7. Viburnum-Vaccinium-Lycopodium
8. Rhododendron

For the spruce-hardwoods forest the site types suggested are as follows:

1. Viburnum
2. Aster
3. Rhododendron

and for the beech-birch gap forests:

1. Carex
2. Athyrium
3. Solidago

Several of the site types of the southern boreal forest correspond rather closely to Heimburger's (1934) site types for the northern boreal forest in the Adirondack region and some are included in the more general topographic subtypes described in Whittaker's (1950) paper. Several of the site types extend throughout the range of the southern boreal forest but others are more characteristic of the specific canopy types.

Following fire the development of spruce and fir stands with characteristic ground cover is extremely slow. In such devastated areas various shrubs, yellow birch, and fire cherry are the dominant vegetation for many years. Development of the spruce and fir stands on the precipitous rocky slopes at high altitudes is also very slow since vegetation is frequently washed down the mountain side following torrential rains in these areas. Windthrow damage is characteristic of much of the high elevation fir forest, which is shallowly rooted on these upper slopes. Following the overthrow of the canopy trees, fir seedlings may develop rapidly producing pole stands of even-aged trees. This cyclic type of reproduction appears typical of these high altitude stands. In contrast with this, in the mid-altitude spruce-fir and the lower altitude spruce forests, individual trees are occasionally uprooted or broken off and with the gradual replacement of these scattered individuals, unevenaged stands are produced. In these stands, also, overmature trees of spruce and fir may die and remain standing for many years after death.

Although many species of the herbaceous plants are found throughout the altitudinal range of the southern boreal forest, certain species or species combinations are more characteristic of specific forest types. More herbaceous species, generally of less coverage, are present at the lower elevations, while fewer species, although frequently of very high coverage, are present at higher elevation.

127 pages. $2.00.

VEGETATION-SOIL RELATIONSHIPS IN SOME ARTEMISIA TYPES IN NORTHERN HARNEY AND LAKE COUNTIES, OREGON

(Publication No. 24,633)

Richard Edgar Eckert, Jr., Ph.D.
Oregon State College, 1957

Major Professor: Charles E. Poulton

A study was initiated in 1954 to develop an improved understanding of the vegetation-soil relationships in northern Harney and Lake Counties, Oregon. This investigation represents a contribution of the Oregon Agricultural Experiment Station to the Research and Marketing Act, Regional Project W-25.

Vegetation and soils were studied together on thirty-one stands. Species constancy, frequency, basal area, density, and line intercept methods were used to analyze the vegetation. A complete morphological description of the soil was made from a representative pit at each study site. These soil profile descriptions were interpreted into nine uncorrelated soil series. A soil sample was taken from each horizon of the profile and the following physical and chemical characteristics determined: pH, resistance of a saturated paste, electrical conductivity of a saturation extract, mechanical analysis, moisture equivalent, 15 atmospheres moisture percentage, and organic matter. Bulk density was determined on some representative profiles. Total exchange capacity and the exchangeable cations, calcium, sodium, potassium, and magnesium, were determined for horizon composites of selected profiles.

A combined interpretation of vegetation and soil, following the poly-climax philosophy, has led to the recognition and characterization of the following four associations and an important phase of one of these associations:

Artemisia tridentata/Agropyron spicatum
Artemisia tridentata/Agropyron spicatum, Stipa thurberiana phase
Artemisia tridentata/Festuca idahoensis
Artemisia arbuscula/Festuca idahoensis
Artemisia arbuscula/Agropyron spicatum

These vegetation types were found both with and without a Juniperus occidentalis overstory. When the former situation was encountered it was interpreted as a Juniperus occidentalis climax to indicate an arborescent ecosystem usually associated with stony ridges and escarpments.

The vegetation mosaic of the study area belongs to the Artemisia tridentata/Agropyron spicatum zone. The climatic climax vegetation is represented by the Artemisia tridentata/Agropyron spicatum association and is the most extensive vegetation type in the study area. The soils of this association belong to the Brown great soil group and represent four soil series. These soils have developed

from alluvial fan and from residual basaltic or rhyolitic parent material.

Artemisia tridentata/Festuca idahoensis and Juniperus occidentalis/Artemisia tridentata/Festuca idahoensis associations represent topographic climaxes. They are encountered only on northerly exposures. One species of perennial forb, Antennaria corymobosa, is diagnostic of these associations. The Brown and Chestnut great soil groups are found associated with these ecosystems.

Artemisia arbuscula/Festuca idahoensis and Juniperus occidentalis/Artemisia arbuscula/Festuca idahoensis associations are the second largest vegetation type in the study area. These associations represent topo-edaphic climaxes in which the soils are shallow, stony and have a moderate to strongly developed B horizon high in clay. The soils of this association belong to the Brown great soil group and have developed primarily from rhyolitic parent material.

The Artemisia arbuscula/Agropyron spicatum association also represents a topo-edaphic climax in which the soils are shallow, stony and also have a moderate to strongly developed B horizon high in clay. The soils studied belong to the Brown great soil group and have developed only from basaltic parent material.

A key to the important ecosystems of the study area was developed. Soils information was omitted from this key since, when dealing with near climax vegetation, the plant communities themselves are adequate indicators of the ecosystem. Soils information can aid the researcher in developing such guides and in the study of deteriorated vegetation.

Several different ecosystems were found to occur on the same soil series, as presently interpreted. Differences in the per cent of available soil moisture holding capacity appears to be an effective way of clarifying these vegetation-soil relationships. This also indicates that it may be possible to improve our soils interpretation at series level by supplementing morphological descriptions with physical and chemical characteristics of the soils. This also suggests that the major limitation to progress in the study of vegetation-soils relationships is the accuracy of soil series and vegetation interpretation.

221 pages. $2.90. Mic 58-4785

THE POSTGLACIAL HISTORY OF VEGETATION AND CLIMATE IN THE LABRADOR-QUEBEC REGION AS DETERMINED BY PALYNOLOGY

(L. C. Card No. Mic 58-921)

John Francis Grayson, Ph.D.
University of Michigan, 1957

The objectives of this investigation were:

1) to reconstruct the vegetational history of the northern Quebec-Labrador region from the time it was deglaciated to the present,

2) to determine the successional stages that occurred in the development of the present vegetation,

3) to use the evidence obtained from this investigation to deduce the climatic changes that have occurred,

4) to date the retreat of the last glacial ice sheet that covered this region, and

5) to obtain further evidence concerning two theories that have developed from previous palynological work. They are the Xerothermic Theory and the Final Period Revertance Theory.

The sediments of four carefully selected bogs, extending over a distance of about 400 miles along a north-south axis through the interior of this region, were analyzed at six inch intervals for their pollen and spore content. The vegetational associations at the various stations were analyzed by the quadrat method. Local successional trends were studied in the bog zonation at the various stations and were compared with the regional vegetational types. The methods used for palynological and vegetational analyses are presented in detail. Calculations for the construction of palynological profiles are based upon the sum of the total pollen and spores rather than the conventional method of using the sum of the arboreal pollen. For each bog, general profiles were constructed for the following groups: arboreal, shrub, bog indicator, and miscellaneous. Individual profiles for selected taxa were also constructed. Radiocarbon age determinations are presented for three of the four bogs.

The following conclusions may be drawn from this investigation.

1. Palynological evidence indicates three regional periods. Tundra vegetation dominated during the first period. A Betula-Alnus association succeeded the tundra and was dominant during the second period. The boreal woodland succeeded the Betula-Alnus association and has been dominant for the past 4000 to 5000 years. Superimposed upon these regional periods, local succession in the vicinity of each station apparently developed in the same order as the regional succession.

2. As for climatic change, only a continued warming trend, with pulsations, from the time of deglaciation of this region to the present is substantiated.

3. Much of this region was deglaciated about 8000 years ago and practically all of it about 6000 years ago.

4. A warm period, which reached its maximum about 3500 years ago, is indicated. It is questionable whether this period was warmer than the present climate of this region.

5. No evidence was found to support the Final Period Revertance Theory in this region. 278 pages. $3.60.

A MONOGRAPHIC STUDY OF THE AMERICAN HIPPOCASTANACEAE

(L. C. Card No. Mic 58-1410)

James Walker Hardin, Ph.D.
University of Michigan, 1957

This work presents the results of a detailed study of the American species of the Hippocastanaceae. The aims have been fourfold: first, to make comparative morphological studies; second, to analyze the patterns of variation over the entire ranges of the species and within local populations; third, to work out the evolutionary relationships among the species; and fourth, to provide a detailed systematic treatment of the species with a workable key for their identification.

The work consisted of a study of approximately 5000

herbarium specimens, supplemented by the analysis of population samples and field examination of the species in the eastern United States. Studies of the characteristics of the trichomes, leaf epidermis, petiole, venation, and floral morphology, a number of which have not heretofore been correlated, were all significant in showing relationships among the species.

The history of the classification of the species in the Hippocastanaceae is reviewed. This is followed by a morphological and anatomical survey emphasizing those characteristics which can be used for the identification of the species and/or for showing relationships among the species. This has revealed a number of features which suggest a more natural classification. The discussions of these characters are supplemented by many illustrations.

A graphical analysis of the clinal nature of certain characteristics in Aesculus pavia and glabra is presented. This explains conspicuous differences in populations of the same species in different localities over wide ranges, and has made possible a re-evaluation of these characters as criteria for the recognition of taxa.

Hybridization among species of Aesculus is discussed in terms of hybrids in cultivation and in nature. The striking variation in many wild populations and the apparently incomplete discontinuities of morphological characters between the four species of Aesculus section Pavia is shown to be a result of introgressive hybridization, rather than an ancestral gene pool. The occurrence of high percentages of abortive pollen in the intermediate forms, and the detailed character analyses with the use of pictorialized scatter diagrams, substantiate this conclusion.

A phytogeographical discussion of the disjunct distributions of the species and the probable origins of the distributions is followed by an evaluation of inter- and intrafamilial relationships. The relative degree of evolutionary advancement for each species of Aesculus is determined from a summation of character differences, and the evolutionary lines of the species are presented graphically.

As a conclusion to the taxonomic study of the family Hippocastanaceae, a total of two genera and fifteen species are recognized (nine of the species in the New World). The genus Billia, with two species, is distributed from southern Mexico to northern South America. Aesculus, with thirteen species, shows a disjunct distribution with species in America, eastern Europe, Japan, China and India. The species of Aesculus are grouped into five sections of the genus. Keys to the genera, sections, and species are followed by a revision of all the American taxa, including hybrids, with lists of synonyms, detailed descriptions, discussion of the ecology and geographic distribution (supplemented by maps), and citation of the specimens examined.

231 pages. $3.00.

EFFECTS OF THE INTERACTION OF VARYING TEMPERATURES AND LIGHT INTENSITIES ON THE RESPONSE OF FLAX TO 2,4-D (2,4-DICHLOROPHENOXYACETIC ACID)

(L. C. Card No. Mic 58-1119)

Lowell Stephen Jordan, Ph.D.
University of Minnesota, 1957

Adviser: R. S. Dunham

Since 2,4-D has become an important herbicide, there have been many investigations to determine the effects of environment, dosage, formulations and time of application on the response of plants to this substance. The influence of these factors on the response of monocotyledons to 2,4-D has been well elucidated. There is, however, no workable hypothesis for the differential response of dicotyledons. Several factors have already been studied in field trials and by histological examination of shoot apices at the Minnesota Agricultural Experiment Station. This thesis represents a continuation of these studies from a different approach.

It was designed to determine the effect of varying day-temperatures and light intensities on the response of flax to 2,4-D. The plants were grown in chambers located in a controlled environment room. The major variables were day-temperatures (65°, 75° and 85°F.) and light intensities (200, 500, 800 and 1100 f.c.) to which the plants were exposed for varying periods both before and after spraying with the triethanolamine salt of 2,4-D at a rate equivalent to six ounces per acre. To measure response, per cent reduction of plant heights, per cent reduction of internodes, and per cent reduction of dry weight were determined at spraying and at harvest. In order to reduce the data an arbitrary figure called "total response" was calculated by summing the per cent reduction of height, internodes and dry weight.

The study was divided into three phases: (A) Constant day-temperatures and light intensities, (B) Post-treatment variation of day-temperatures and light intensities, and (C) Pre-treatment variation of day-temperatures and light intensities. The data from all three phases show that light intensity both before and after treatment is important with the greatest response occurring at 200 f.c. and the least response at 1100 f.c. These results agree with those of some investigators. Others report greater response of plants to 2,4-D at high light intensity. They conclude that the greater response at high light intensity results from rapid 2,4-D translocation with photosynthates. It is probable that translocation was not the principal factor affecting the response of flax under the conditions of this study.

It was found that temperature both before and after treatment affected the response of flax to 2,4-D. Generally the greatest response occurred at 85°F. and the least at 65°F. These results agree with those of other investigators.

There was an interaction between temperature and light intensity. When the light intensity was 1100 f.c. both before and after treatment there was very little difference in the response at 65°, 75° or 85°F. When the light intensity was 200 f.c. either before or after treatment the differences were large with the greatest response occurring at 85°F. It is proposed that the interaction between temperature and light intensity may result from their effects on the balance between respiration and photosynthesis.

The items following each abstract are: the number of manuscript pages in the dissertation, its cost on microfilm, and the Library of Congress card number. Enlargements 5-1/2 x 8-1/2 inches, 4 cents per page. No postage is charged if check or money order accompanies order.

It was concluded that injury to flax in the field from 2,4-D would be greater under hot, cloudy conditions than under bright sunshine and relatively cool conditions.

66 pages. $2.00.

CLARIFICATION OF THE ECHINOCEREUS ENNEACANTHUS COMPLEX

(L. C. Card No. Mic 58-1435)

Winifred Olivia Moore, Ph.D.
University of Michigan, 1957

The purpose of this study is to clarify the identification and classification of Echinocereus enneacanthus Engelmann and the two allied species, E. dubius (Engelm.) Rümpler and E. stramineus (Engelm.) Rumpler, all low, cespitose, purple-flowered cacti with edible fruit, frequent in the Texan and Mexican parts of the Rio Grande valley. Cactologists had expressed uncertainty concerning the proper classification of the three species, and especially about the definition of E. enneacanthus which was said to be variable.

To resolve the problems of identification and classification thus raised, a collection of fresh specimens of these species was made during a field trip in 1955 to the Texan side of the Rio Grande valley.

Data from the fresh specimens was compared with that obtained from herbarium material. The forms of the plants, the roots, spines, epidermis, flowers, fruit, and seeds were studied, and the chromosomes were counted. Differences in stem shape, rib number, and rib shape were noted among the three species.

As the spines were studied it appeared that their differences in size and arrangement followed a pattern, and the specimens of Echinocereus enneacanthus were divided into three forms according to their spine characters. The setting up of these infraspecific categories should resolve the present confusion brought about by the wide but minor differences in spine characters.

Earlier German botanists had used the epidermis and hypodermis of some of the cacti in speciation, but examination of these tissues of the three species brought out significant trends, but no constant characters, with the exception of the cuticle of E. stramineus which has a pseudocellular appearance.

Flower examination revealed minor but constant differences in size, number of stigma-lobes, tepal number, and character of ovary spines. Seeds showed significant trends, but no reliable constant characters.

Chromosome counts of species and forms showed a diploid number of 22.

The original descriptions of Engelmann clearly define and contrast the species. However, illustrations of the original work contain errors in which drawings of E. dubius are labeled "E. stramineus", and this mistake may have had far reaching and unfortunate results.

The three species together with the three forms of E. enneacanthus are described. The species descriptions are amended revisions of the originals, and the three forms, E. enneacanthus f. enneacanthus, E. enneacanthus f. intermedius, and E. enneacanthus f. brevispinus, are described for the first time. 176 pages. $2.30.

A CONTRIBUTION TO THE LIMNOLOGY AND MYCOLOGY OF THE PHYCOMYCETES WHICH INVADE PLANKTONIC ORGANISMS

(L. C. Card No. Mic 58-1447)

Robert Andrew Paterson, Ph.D.
University of Michigan, 1957

The purpose of this investigation was to study the limnological rôle of aquatic fungi in nature and to further our knowledge of the taxonomy and morphology of these organisms. Although observations were primarily concerned with members of the Chytridiales, some saprolegniaceous fungi are discussed.

Part I, the limnological investigation, was conducted at Frains Lake, Washtenaw County, Michigan, from June 10, 1955 through June 24, 1956. Involved in the study were two chytrids. One, Rhizosiphon anabaenae (Rodhe and Skuja) Canter, was found to be parasitic on the blue-green alga, Anabaena planktonica Brunnthaler, and the other, Amphicypellus elegans Ingold, was saprophytic on dead thecae of the dinoflagellate, Ceratium hirundinella (O. F. M.) Schrank. Quantitative methods were employed in studying the relationships of these organisms to the following environmental conditions: temperature, dissolved oxygen, hydrogen-ion concentration, and total alkalinity. The data derived from the quantitative study indicate that several physical-chemical and biological relationships occur. One of these concerns the host-parasite relationship. The percentage of parasitism of Anabaena planktonica by Rhizosiphon anabaenae is greatest during the decline in numbers of the blue-green alga but there are strong indications that such a decline is not due to parasitism but to environmental physical-chemical factors. Furthermore, the senility of the declining algal cells is more likely to be a factor accounting for the presence of the parasite than for the parasite to be a cause or to hasten the decline in the algal population. Other correlations that can be made are the incidence of parasitism and dissolved oxygen, as well as pH, which perhaps show that the existence of the parasite is dependent upon an optimum of these chemical conditions. In the case of saprophytism, no correlation can be shown between percentage of saprophytism and numbers of either living or dead thecae of Ceratium hirundinella. However, maxima in percentage of saprophytism can be correlated with certain temperature and total alkalinity ranges. Furthermore, a decline in dissolved oxygen occurs during the periods of maximum percentage of saprophytism.

Part II of the investigation, the taxonomic and morphological study, was conducted on certain Michigan lakes for the purpose of investigating all the aquatic fungi that could be found inhabiting planktonic organisms. Of the 34 species which are discussed, 30 are chytrids and 4 are saprolegniaceous forms. Four of the chytridiaceous fungi are unique and are designated as new species.

From Part II of the study it can be seen that these organisms are rare, and due to their perishability in the laboratory are difficult to study, as evidenced by the fairly small number of aquatic fungal species encountered. That the types of forms on plankton are in need of further study is evidenced by the fact that in this investigation 4 new species and 9 new to the United States were found.

201 pages. $2.65.

SOME ASPECTS OF THE METABOLISM OF THE MARINE DIATOM, NITZSCHIA CLOSTERIUM (EHRENBERG) WM. SMITH

(L. C. Card No. Mic 58-871)

Joon Hee Rho, Ph.D.
Duke University, 1958

Supervisor: A. W. Naylor

A study has been made of the growth characteristics, qualitative and quantitative analyses of metabolic products have been made, light and dark assimilation of carbon dioxide has been measured under several environmental conditions, and the respiratory pattern has been partially determined for the marine diatom, Nitzschia closterium (Ehlenberg) Wm. Smith. Miquel's medium modified by Ketchum and Redfield has been further modified by enriching natural sea water with 89 mg. of sodium silicate per liter and by the addition of EDTA and citric acid as chelating agents for iron and other elements. Using the thus modified medium, characteristic growth of N. closterium was measured in terms of cell number, total nitrogen, and dry weight. Cell multiplication proved to be independent of the synthesis of certain cell substances.

There were very small quantities of free sugars present in the cells. Only 3.1 percent of the dry weight was measureable as total nitrogen. Several free amino acids were found to be commonly present. Alanine, histodine, and lysine were always present in fair amounts and several others appeared in traces. Amino acids present in the protein hydrolysate proved to be the same as previously reported. Fat, as measured by petroleum ether extraction made up 3.9 percent of the total dry weight. Lactic acid was shown to be present in fair amounts and indications obtained that it quickly labeled with carbon from $C^{14}O_2$.

Photosynthesis and respiration were differently affected by environmental conditions. Light saturation was achieved by a population of 1.3×10^9 cells in 2.5 ml. of medium at around 600 f.c. at 25^0 C. Temperature markedly affected the rate of photosynthesis. There was a rather narrow maximum range somewhere between 25^0 and 35^0 C, whereas the respiration rate appeared to be less affected by high temperature, a broad temperature maximum occurring at around 35^0 C. Effects of pH on photosynthesis, respiration, and growth rate were studied. There was a high rate of photosynthesis at pH 5.5, and peaks of respiration and growth at pH 7.5.

Early products of photosynthesis like phosphate esters, sugars, organic acids, and amino acids were found to be much the same as in other plants. However, the occurrence of radioactive lactic acid, the rapid tagging of histidine, and a steady increase in radioactivity in lysine with time were unusual. Another dissimilarity in the metabolism of this organism from other green algae and higher plants was the distributional pattern of radiocarbon in the products of dark $C^{14}O_2$ fixation. There was little tag in malic acid and a surprisingly large amount of radioactivity was spread through a group of amino acids in which ornithine, citrulline, histidine, and lysine were most heavily labeled. Among several organic compounds tested for heterotrophic assimilation, none of the compounds supported growth in the dark but glycine, lysine, pyruvate, and glucose apparently stimulated growth in the light. Experiments using C^{14} labeled compounds revealed that this organism metabolized some organic compounds in the light but was unable to metabolize the same compounds in the dark.

Two extremely different respiratory quotients were obtained in two different buffer systems. These quotients were 0.19 in acetate buffer for the first four hours and 0.56 in phosphate buffer in a corresponding period. Respiration was strongly inhibited by iodoacetic acid and sodium arsenite but not by potassium cyanide. These results have been discussed with particular reference to substrate utilization and the possible occurrence of a "glyoxylate by-pass" in the Krebs cycle operating in this organism. 138 pages. $2.00.

GROWTH AND NITROGENOUS CONSTITUENTS OF ATROPA BELLADONNA L. AS AFFECTED BY DIFFERENT SOURCES OF NITROGEN

(L. C. Card No. Mic 58-1259)

Leo James Schermeister, Ph.D.
University of Illinois,
Chicago Professional Colleges, 1957

Supervisors: Ralph F. Voigt and G. L. Webster

Introduction:

The importance of atropine as a cholinergic blocking agent motivated this investigation of the constituents in Atropa belladonna L. The interrelationship between nitrogen source and biosynthesis of nitrogenous organic compounds, and present concepts as to alkaloid precursors indicated a need for further study. For these reasons, the present investigation is concerned with the growth and nitrogenous constituents of Atropa belladonna L. as affected by different sources of nitrogen.

Experimental Methods:

Belladonna plants grown in Hoagland and Arnon nutrient solution at a pH of 5.8 were furnished nitrogen as both nitrate and nitrate plus ammonia varied through a fairly wide range, while the other nutrients were kept constant at the level used by Hoagland and Arnon. The levels of nitrogen were as follows:

5, 10, 15, 20, 25, and 30 mg. equiv. of nitrogen as nitrate;

5, 20, and 30 mg. equiv. of nitrogen as nitrate plus ammonia in the rate of 1:4.

The entire growth period took place in a greenhouse, in which the natural day length was supplemented to a photoperiod of 18 hours. The temperature was maintained at a minimum of 70^0 F. The growth period was terminated at the flowering stage, at which time fresh and dry weights of the plant parts were determined. Representative portions of fresh tissue were analyzed for total nitrogen, ammonia, amide, nitrite, nitrate, free and combined amino acids.

Total nitrogen was determined by the Kjeldahl method; while ammonia, amide, nitrite, and nitrate fractions were separated on an ion exchange resin column and determined by a modified Kjeldahl procedure. Free amino acids and, after acid hydrolysis, those that had been combined in protein were quantitatively determined by partition chromatography and reaction with ninhydrin. Dried

tissue of the respective plant parts was also analyzed for total alkaloids by electrometric titration.

Experimental Results:

Criteria used in determining morphological development included shoot elongation, branching, number of leaves, flowers, plant part ratios, and fresh and dry weights of the plant and its separated parts. Quantities of the different nitrogenous fractions found present in each plant part were correlated with nitrogen source and growth produced.

Summary:

1. Atropa belladonna L. was successfully grown in water culture using a range of NO_3 and NH_3-NO_3 sources.

2. Growth of the plant with NH_3-NO_3 was better than with NO_3 alone. The most satisfactory growth was obtained from both nitrogen sources at 20 mg. equiv. of nitrogen.

3. Small amounts of nitrite and ammonia in tissue indicate their transient position in protein synthesis.

4. Low levels of nitrogen stimulated root growth, while high NO_3 levels increased succulence and nitrate accumulation.

5. Free amino acids amounted to one-tenth or more of the total nitrogen present. The largest proportion of these compounds is composed of aspartic acid and its amide asparagine; glutamic acid and its amide glutamine; γ-aminobutyric acid, and proline.

6. The NH_3-NO_3 source stimulated greater formation of the 5-carbon dicarboxylic acids, while the NO_3 source stimulated greater production of the 4-carbon acids.

7. The protein fraction amounted to one-half or more of the total nitrogen, its composition being constant. The protein of leaf and root were similar but differed markedly from that of stem.

8. The alkaloid concentration was greatest in the roots grown in NH_3-NO_3, and coincided with small amounts of both free and combined proline.

9. Associated with large amounts of alkaloid in roots are extremely large amounts of γ-aminobutyric acid, which could be an alkaloid precursor.

10. The experiment indicates that protein and alkaloid are both products of a soluble nitrogen pool and are not directly related in their synthesis or hydrolysis. Proline, hydroxyproline, and γ-aminobutyric acid appear to be involved in alkaloid synthesis. 134 pages. $2.00.

THE AGARICACEAE OF THE PINE BELT AND ADJACENT AREAS IN EASTERN TEXAS

(L. C. Card No. Mic 58-1004)

Harry Delbert Thiers, Ph.D.
University of Michigan, 1956

The purpose of this research was to determine the characteristics of the mushroom flora of the forested portion of eastern Texas, an area in which such a study had not been made. The project involved the collection and identification of all agarics found as well as recording data on relative abundance, relationship to substratum or phanerogamic species, the habit and fruiting periods. The field work was carried out over a period of three years, during which time the data included in the descriptions making up the body of this thesis were recorded. The collections were dried and are deposited in the herbarium of the University of Michigan, Ann Arbor, Michigan and in the cryptogamic herbarium of the Agricultural and Mechanical College of Texas, College Station, Texas.

The first part of the report is a discussion of the environmental conditions existing in the area and of the phanerogamic vegetation. Generally the area is characterized by moderate rainfall, high summer temperatures, relatively mild winter temperatures, low humidity during the summer and a high evaporation rate. The soil is mostly sandy or moderate to heavy clay and is markedly low in many minerals and organic matter. The entire area is forested either by a mixture of pines and hardwoods or with only hardwoods. Pines are represented by three species, Pinus taeda, Pinus echinata and Pinus palustris, and oaks, hickories and sweet gum are the most common hardwoods. The forest is typically open and only in few areas is a dense canopy present.

The second part of the report contains descriptions of the genera and species of agarics occurring in the area. Representatives of fifty-four genera and approximately 350 taxa below generic rank were collected, however, because of either small collections or inadequacies in the literature only fifty-two genera and slightly more than 200 species are included as accurately determined. Twenty-five species and a smaller number of varieties and forms are presented as new. Species belonging to Amanita, Boletus, Lactarius, Marasmius, Mycena and Russula were most abundant. Amanita appears to be best represented with approximately half of the total number of species reported from North America having been found. More new species were found in Lactarius than in any other genus. Several genera, such as Cortinarius, Psilocybe, Pholiota and Galerina, are apparently poorly represented. Representatives of most of the common genera were found with Limacella and Kuehneromyces being the most notable exceptions.

The terrestrial species were most abundant, and many species were found in open areas devoid of any woody vegetation. Lignicolous forms were next in abundance but were not as common as expected; this is probably due to rapid loss of moisture by the decayed wood. Coprophilous forms were least common, and appeared only immediately following rains. Three fruiting patterns were observed: those species which fruit, in varying degrees of abundance, throughout the year; those species which fruit only immediately following rains, and those species which fruit only in the spring and fall. A few species were observed fruiting either only in the spring or the fall.

The agaric flora is generally similar to that found in the southeastern evergreen forest, but includes some apparently tropical species which have not been previously reported from the United States. Among these are species formerly reported from Mexico, the West Indies or Central America. In addition species were found which had been known only from Europe or South America.

577 pages. $7.35.

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THE EFFECTS OF CERTAIN SUBSTITUTED BENZOIC ACIDS ON HIGHER PLANTS

(L. C. Card No. Mic 58-1010)

Leo Cornelis Vander Beek, Ph.D.
University of Michigan, 1957

The purpose of this investigation was to study the effects of a number of substituted benzoic acids, and in particular chlorinated benzoic acids, on root and shoot development of seedlings and established plants of several species.

Of the chlorinated benzoic acids investigated, 2,3,6-trichlorobenzoic acid was the most active and 2,6-dichlorobenzoic acid the least active in inhibiting elongation of the primary root of cucumber; others tested were intermediate in activity.

It is usual that root development is repressed by far lower levels than shoots. However, shoots of oats, barley and cucumber seedlings, treated in the dark with levels of 2,3,6-trichlorobenzoic or 2,6-dichlorobenzoic acids which cause little or no inhibition of root development, failed to assume the normal vertical position. This was presumed to be due to repression of the geotropic response. Other plant species responded similarly to these two acids.

A method was developed whereby a quantitative relationship was established between concentration of 2,3,6-trichlorobenzoic or 2,6-dichlorobenzoic acids and extent of repression of the geotropic response of shoots of oats. In this method hulled oat seeds are inserted after germination near the upper edge of a small cube of cellulose sponge which is placed in the test solution contained in a glass humidity chamber. The chamber is maintained under red light at 25° C until the seedlings are 96 hours old. A shadowgraph of the seedlings is made and the angle formed by the seed and shoot is measured. In this test 2,3,6-trichlorobenzoic acid was shown to be much more active than 2,6-dichlorobenzoic acid. Of the two widely studied growth regulators, 2,4-dichlorophenoxyacetic acid and 2,3,5-triiodobenzoic acids, only the latter was found to be capable of interference with the geotropic response, which is apparently not related to activity as an auxin.

The phototropic response of seedlings of a number of species was also similarly impaired when treated with 2,3,6-trichlorobenzoic and 2,6-dichlorobenzoic acids.

A structural requirement for activity in the repression of the geotropic response, which appears to be associated with positions 2 and 6 of the benzene ring, was demonstrated. Among the variously substituted benzoic acid derivatives tested, only 2,3,6-trichlorobenzoic and 2,6-dichlorobenzoic acids were effective.

No differences in elongation from untreated controls were found in cucumber hypocotyls treated with 2,3,6-trichlorobenzoic acid even though shoots of treated seedlings deviated from the normal vertical position. A method was developed for the measurement of elongation induced in segments of cucumber hypocotyls. No elongation was found in segments treated with 2,3,6-trichlorobenzoic acid. If segments were simultaneously exposed to indoleacetic acid and 2,3,6-trichlorobenzoic acid, the elongation which occurred was equal to that induced by indoleacetic acid alone. However, indoleacetic acid did not induce elongation in segments of hypocotyls from seedlings grown in 2,3,6-trichlorobenzoic acid.

Substituted benzoic acids cause a diversity of morphological responses in higher plants. Most of the responses observed in established bean and tomato plants treated with 2,3,6-trichlorobenzoic and 2,6-dichlorobenzoic acids were similar to those previously reported. However, in tomato plants there was development of extreme epinasty, and large swellings at the nodes and randomly along the internodes. In bean plants large terminal galls appeared. These two acids, therefore, possess morphogenic properties which are distinctive, and appear to separate them from other highly active growth regulators such as 2,4-dichlorophenoxyacetic acid. These unusual morphogenic properties together with their capacity to affect directional growth render them outstanding. 118 pages. $2.00.

ISOLATION, GROWTH, AND DIFFERENTIATION OF TRAGOPOGON TISSUE CULTURES ON DEFINED MEDIA

(L. C. Card No. Mic 58-1016)

Barbara Eloise Whalley, Ph.D.
University of Michigan, 1957

The isolation of Tragopogon tissue, its morphology, the development of a defined medium for its growth, and the chemical control of its differentiation in culture form the basis of this dissertation.

Tragopogon was selected because it was one of the plants which produced leaves and roots from root discs; it was therefore suitable for studies concerning the control of differentiation. In addition it had a root sufficiently large to permit the removal of sterile segments.

Continuing cultures of both leaf- and root-derived tissues were established on a modified White's medium in which coconut milk was substituted for 20 percent of the distilled water. The percentage increase in fresh weight was used as a measure of growth and inocula were taken from stock cultures 10 to 20 days old -- that is, in the log phase of growth. Cultures were maintained in the dark at 27°C for 25 days. Under these conditions increases in growth averaging approximately 2000 percent were obtained.

Initially the cultures could not be grown without the addition of coconut milk to the medium. However, by means of the auxanographic technique the types of chemicals needed for growth were delimited. The Kruskal-Wallis H test, a nonparametric test of significance, was used to assess both simple and interaction effects of the substances investigated. A completely defined medium consisting of a mixture of amino acids and adenine sulphate in addition to the modified White's medium was evolved. Growth obtained on this medium was comparable to that obtained on medium containing coconut milk.

Tissue cultures of both the root and leaf of Tragopogon produced most of the cell types found in the parent plant. At no time, however, did they form organs without the addition of differentiation-inducing factors such as hydrolyzed ribose nucleic acid, adenine sulphate, or diphenyl urea. This is believed to be the first report that diphenyl urea acts as an organizing factor.

After being maintained in culture for several years the root tissue appeared to undergo habituation, although not to indole acetic acid as is the usual case. Habituation resulted in an altered response to diphenyl urea, a compound isolated from coconut milk.

It was found that when a high concentration of tyrosine was used in the medium the formation of the enzyme tyrosinase was induced. The enzyme was extracted and it was shown to act on dihydroxy phenylalanine, a common substrate for this enzyme. 101 pages. $2.00.

The items following each abstract are: the number of manuscript pages in the dissertation, its cost on microfilm, and the Library of Congress card number. Enlargements 5-1/2 x 8-1/2 inches, 4 cents per page. No postage is charged if check or money order accompanies order.

CHEMISTRY, GENERAL

A STUDY OF SOME SALTS OF CYCLOHEXYLPHOSPHONIC ACID

(L. C. Card No. Mic 58-1288)

James Birdsey Gregory, Ph.D.
Stanford University, 1958

Although much information has been developed on the synthesis and reactions of phosphonic acids, little attention has been given to the inorganic salts of these compounds and their application to the analysis for common metal ions. In this work the sodium, calcium, magnesium, strontium, and barium salts of cyclohexylphosphonic acid were prepared and studied.

Cyclohexylphosphonic acid was chosen because it may be prepared pure in relatively large amounts by the reaction of oxygen, cyclohexane, and phosphorus trichloride according to the method of Clayton and Jensen (J. Amer. Chem. Soc., 70, 3880 (1948)). The work of these authors was confirmed with the exception that ionization constants of the acid were found to be 2.4×10^{-3} (K_1) and 7.1×10^{-9} (K_2). These values correlate well with reported ionization constants of other phosphonic acids. The solubility of the acid in water was found to be 4.95 g./100 ml. of solution.

Sodium salts were prepared by the evaporation of aqueous solutions containing equivalent amounts of the acid and sodium hydroxide. Alkaline earth and magnesium cyclohexylphosphonates were precipitated from hot alkaline aqueous solutions containing the acid and metal chlorides or nitrates. The salts are white, powdery solids having the general formula $MC_6H_{11}PO_3$ without water of crystallization at 110° C. All decomposed on heating giving off a characteristically unpleasant odor. Wet oxidation with sulfuric acid produced the pyrophosphates.

The sodium salts are very soluble in water; the barium salt is moderately soluble. Solubilities of other prepared salts are as follows:

	Solubility, mol./1	Solubility Product Constant, $mol.^2/1.^2$.
Ca Salt	2.5×10^{-4}	5.7×10^{-8}
Sr Salt	1.1×10^{-3}	1.2×10^{-6}
Mg Salt	7×10^{-4}	4×10^{-7}

Precipitation studies showed the alkaline earth salts to exhibit a marked tendency to form supersaturated solutions at room temperature, suggesting the formation of soluble complexes between metal and cyclohexylphosphonate ions. Interference with the precipitation of the least soluble salts by the more soluble ones supports this view. Equilibrium may be attained by heating the systems or by adding miscible organic solvents. The presence of ammonium ion increases the solubility of the alkaline earth salts even in alkaline media beyond that which may be explained on the basis of simple salt effect. Again the formation of soluble complexes is suspected.

Under proper conditions of test it is possible to detect as little as 1 mg. of calcium ion in the presence of 20 mg. of strontium and over 100 mg. of barium in 1 ml. of solution by precipitation as the cyclohexylphosphonate. Magnesium interferes and must be absent. The method does not appear to be competitive with current standard qualitative schemes.

A rapid volumetric method for the quantitative determination of calcium has been developed. Calcium cyclohexylphosphonate is precipitated in an excess of the sodium salt and the excess determined by titration with standard hydrochloric acid. Values are accurate within 0.2 mg. of the amount of calcium present up to 50 mg. Errors introduced by the presence of magnesium, strontium, and barium vary inversely with the solubilities of their respective salts.

125 pages. $2.00

SOME ANALYTICAL APPLICATIONS OF QUINQUEVALENT VANADIUM

(L. C. Card No. Mic 58-1308)

Donald Markham West, Ph.D.
Stanford University, 1958

The employment of acidic solutions of vanadium (V) for the volumetric analysis of inorganic reducing agents has been rather extensively investigated; few studies have been made of the reactions these solutions undergo with organic substances. The present investigation was undertaken to determine what application, if any, could be made of vanadate solutions for the volumetric oxidation of several classes of organic compounds. In addition, the kinetics of the reaction between vanadium (V) and glycerol were studied.

Dilute aqueous solutions of the organic substance under consideration were treated with an excess of vanadium (V); heating of the samples was generally effected with a boiling waterbath. Upon completion of the heating period, the excess vanadate was determined by titration with standard Mohr's salt, N-phenylanthranilic acid being employed as indicator. The heating period for successive samples was increased until an essentially constant value was obtained for the ratio between the number of equivalents of vandate consumed per formula weight of reducing agent. This stoichiometric information, coupled with identification of oxidation products of several reactions, made it possible to infer the course of the reaction in a number of instances.

It was found that formic acid, the product of a number of oxidations, undergoes a slow oxidation under conditions of high sulfuric acid concentration and at elevated temperatures. Acetic acid is unaffected, even under very strenuous conditions.

The items following each abstract are: the number of manuscript pages in the disseriation, its cost on microfilm, and the Library of Congress card number. Enlargements 5-1/2 x 8-1/2 inches, 4 cents per page. No postage is charged if check or money order accompanies order.

Mandelic acid was found to be readily oxidized to carbon dioxide and benzoic acid; conditions were found under which glycolic and lactic acids react in an analogous fashion, products of the 4-electron oxidation being carbon dioxide and the carboxylic acid possessing one carbon atom less than the parent substance.

It was found that oxalic acid is rapidly and quantitatively oxidized to carbon dioxide; no simple stoichiometry can be envisioned to account for the extensive oxidation of the next member in the series, malonic acid.

When heated strongly, maleic and fumaric acids are oxidized by vanadium (V) to carbon dioxide and water; under milder conditions the cis-isomer is the more readily oxidized, probable products being equimolar quantities of carbon dioxide and formic acid.

Ethylene glycol is oxidized to formic acid, as is glycerol. On the basis of oxidant consumption, it is likely that trimethylene glycol yields the same product. Propylene glycol was found to be attacked readily, although not stoichiometrically.

Aniline was found to be readily attacked under mild conditions. The extent of vanadate consumption does not correspond to any simple stoichiometry.

The reaction between vanadium (V) and glycerol, lactic acid and oxalic acid were selected for further study. Methods for volumetric analysis of each were developed. It was further established that sodium oxalate is a suitable primary standard for vanadate solutions.

The kinetics of the vanadate oxidation of glycerol was briefly investigated. It was found that the reaction is pseudo first-order with respect to vanadium (V) and to glycerol, and pseudo second-order with respect to hydrogen ion concentration. A limited study of the oxidation of cis- and trans-cyclohexanediol showed the same relationships; the cis-isomer was found to be more readily attacked.

By postulating that the rate-determining step in these reactions is the first-order disproportionation of a coordination complex between vanadium (V) and the polyhydric alcohol, it was found possible to account for the available kinetic findings. 146 pages. $2.00

CHEMISTRY, ANALYTICAL

SPECTROPHOTOMETRIC INVESTIGATION OF THE ANALYTICAL REAGENT, 1-(2-PYRIDYLAZO)-2-NAPHTHOL, PAN, AND ITS COPPER, NICKEL AND PALLADIUM CHELATES

(Publication No. 24,649)

Burton Frank Pease, Ph.D.
Oregon State College, 1957

Major Professor: Max B. Williams

The dye, 1-(2-pyridylazo)-2-naphthol, PAN, has in recent months been used as a valuable indicator for the versene titration of a variety of metals. It has also been suggested as a colorimetric reagent for the determination of zinc, copper, nickel and cobalt. Because of the rapidly expanding use of this reagent it seems desirable to obtain more information concerning the dye and some of its metal chelates.

It has been demonstrated that the dye is an acid-base indicator which may exist in three different forms. Absorption spectra of these forms have been obtained at various pH values in water and 20% dioxane. The dissociation constants have been determined to be 1.26×10^{-2} and 6.3×10^{-13} in the latter solvent. The absorption spectra of the dye in methyl and ethyl alcohol have also been determined and found to be similar to those obtained in water and 20% dioxane.

The absorption spectra of the copper-dye chelate was obtained and the existence of only a one to one complex at all pH values was verified by Job's method and spectrophotometric titrations. The equilibrium constant for the reaction $HKE + Cu^{++} \rightleftharpoons CuKE^{+} + H^{+}$ was found to be 6.4×10^{3} and the stability constant for the chelate is approximately 10^{16}. The molar absorbancy index of the copper chelate is 2.4×10^{4}. A standardization procedure for the determination of concentration of a dye solution has been developed. This is based upon the spectrophotometric titration of the dye in 20% dioxane with a standard Cu(II) solution at pH 5.0.

The nickel-dye chelate has been shown to be a one to one complex in 20% dioxane at pH 5.4 by Job's method and absorption spectra of the chelate were obtained at this pH. The molar absorbancy index of the nickel chelate was found to be 2.2×10^{4}.

The formation of a green palladium chelate, in contrast to the usual red metal-PAN chelate, suggested the possibility of a colorimetric palladium determination. A chloroform extraction procedure has been developed utilizing this characteristic at pH of less than 1. The absorption spectra of the palladium chelate in the chloroform extract showed strong bands at 620 and 675 mu. The molar absorbancy indices of the palladium chelate in chloroform and at these wavelengths was found to be 1.31×10^{4} respectively. The interferences of other Group VIII precious metals have been determined.

117 pages. $2.00. Mic 58-4786

CHEMISTRY, BIOLOGICAL

STUDY OF LIPID SYNTHESIS IN CELL-FREE EXTRACTS OF SACCHAROMYCES CEREVISIAE

(L. C. Card No. Mic 58-1072)

Zina Kiziuta Booher, Ph.D.
University of Washington, 1957

The preparation and some properties of a cell-free system from Saccharomyces cerevisiae, capable of incorporating radioactive acetate into sterols and fatty acids, has been described.

Several methods of cell breakage were investigated. It was found that grinding yeast paste with dry ice, followed by incubation of the extract in 0.1 M phosphate buffer, 5-10 μ moles ATP and about 200 μ moles acetate constituted optimum conditions for sterol synthesis by these preparations.

Differential centrifugation of the cell-free extracts showed that both the particulate and soluble fractions were necessary for lipid synthesis. This activity was concentrated in particles sedimenting at 26,000 x g.

78 pages. $2.00.

BIOLOGICAL OXIDATION OF SORBITOL

(Publication No. 24,631)

Joseph Thomas Cummins, Ph.D.
Oregon State College, 1957

Major Professors: Vernon H. Cheldelin and Tsoo E. King

The oxidation of sorbitol by soluble extracts of A. suboxydans proceeds by two pathways depending upon which pyridine nucleotide is present. In the presence of TPN, sorbose is formed. In the presence of DPN fructose is produced. Both products of the oxidation of sorbitol have been identified by paper chromatography, optical rotation, crystaline form and melting point of the phenylosazones.

The fructose can then be phosphorylated and further oxidized by cell-free extracts by means of the Horecker pentose cycle. Both hexose and pentose were shown to accumulate in digestion mixtures, when TPP was removed from transketolase.

The oxidation of a number of synthetic polyhydroxy compounds has been shown to be catalyzed by non-specific dehydrogenase systems of A. suboxydans.

DPN-specific sorbitol dehydrogenase has been purified a minimum of 13 fold by a three step procedure. This enzyme has been shown to be sorbitol specific. Some of the more common sugar alcohols and a few compounds showing high dehydrogenase activity were not active toward the final enzyme preparation.

Mannitol dehydrogenase is TPN specific and may be the same enzyme as the TPN-sorbitol dehydrogenase. Both these enzymes proportionately lose activity in the purification of the DPN sorbitol dehydrogenase. Mannitol is three times as active as sorbitol toward the preparations studied.

All attempts to separate the TPN-activity from the DPN-activity failed. Both these enzymes have a pH optimum of 8.5 and are stimulated by Mg^{++} and Mn^{++}. However, the TPN enzyme is more fragile, and the DPN enzyme has a much broader range of activity with pH.

A heat denaturation method involving protection of the enzyme by both the cofactor and substrate was used for the DPN linked sorbitol dehydrogenase. This effect has not previously been shown.

62 pages. $2.00. Mic 58-4787

STUDIES OF THE INTERACTION OF PROTEINS WITH DETERGENTS: EFFECTS OF pH, IONIC STRENGTH AND DETERGENT STRUCTURE

(L. C. Card No. Mic 58-1131)

Paul Melnychyn, Ph.D.
University of Minnesota, 1957

Adviser: D. R. Briggs

A dialysis-equilibrium method was used to determine the interaction isotherms of ovalbumin and beta-lactoglobulin with octylbenzene-sodium-sulfonate in acetate-chloride buffers (0.1 and 0.2 ionic strength, pH 4.0 and 5.0) and trishydroxy-methylamino methane-chloride buffer (0.1 and 0.2 ionic strength, pH 8.5). Native ovalbumin did not bind a detectable amount of detergent whereas native beta-lactoglobulin bound 2-3 moles of detergent. Each protein was subject to modification, (a conformation change), by the detergent. As the acidity of the system was increased the concentration of detergent required to bring about the conformation change was decreased. The principal effect of increase in ionic strength was to decrease the critical micelle concentration of the detergent and not upon the interaction capacity or affinity of the protein for the detergent. A form of the BET equation was applied to the various isotherms of the modified protein. Neither pH nor ionic strength had any determinable effect upon the number of reactive sites on this form of the protein but an increase in pH was accompanied by a decrease in the affinity of the protein for the detergent. The modified form of ovalbumin exhibited about thirty-six reactive sites, which is somewhat less than the total number of basic groupings in ovalbumin (i.e. forty-two). The modified form of beta-lactoglobulin showed about thirty-three sites compared to a total of thirty-nine basic groups known to be present in the native protein. It appears that some of the sites are still not accessible even after modification of the protein by detergent.

Interaction studies with the acetylated proteins indicated that acetylation denatured the proteins and decreased the number of reactive sites to sixteen for ovalbumin and to twenty for beta-lactoglobulin.

Studies with ovalbumins heated at 70°C, at pH 5.0 and 8.5, indicated that at the higher pH the protein was only slightly denatured and could be further modified by detergent, whereas heating at pH 5.0 completely denatured the protein. Heating beta-lactoglobulin at 65°C, at pH 7.0, did not modify the protein insofar as detergent interaction was concerned. The adsorption isotherm corresponded to that obtained with the native protein under similar conditions. Beta-lactoglobulin heated at 90°C was fully denatured and the number of reactive sites was reduced to twenty-two.

Evidence was presented to show that the interaction was electrostatic in nature and that modification of the protein by means of the detergent involved a competitive reaction for the basic group involved in salt-linkages in the native protein and between the sulfonate groups on the detergent molecules and the carboxyl groups initially combined in these salt-linkages. Increased acidity in the system favored the sulfonate groups in this competition.

Structure of detergent did not affect the interaction with the modified form of beta-lactoglobulin. Hexylbenzene-sodium-sulfonate, heptyl-4-benzene-sodium-sulfonate and octylbenzene-sodium-sulfonate showed the same affinity

for this protein. The same number of sites were also available to interaction with each of these detergents.
241 pages. $3.15.

HEXOSE UPTAKE IN ASCITES TUMOR CELLS

(L. C. Card No. Mic 58-1441)

Marshall Warren Nirenberg, Ph.D.
University of Michigan, 1957

Experiments with Ehrlich carcinoma and Gardner lymphosarcoma ascites tumor cells have indicated that a glycolytic step prior to hexokinase action exists and that it functions as a monosaccharide transport mechanism.

Manometric measurements of anaerobic glycolysis demonstrated that both glucose and fructose were utilized by the tumor cells whereas galactose was not. Galactose markedly inhibited fructolysis in the intact cells, but it had very little or no effect upon glucolysis. Lineweaver-Burk plots demonstrated that the inhibition was competitive.

In sharp contrast to the results obtained with intact cells, galactose did not inhibit fructolysis in homogenates. The hexokinase activity of clarified Ehrlich carcinoma and Gardner lymphosarcoma tumor homogenates was assayed by a spectrophotometric determination of TPN reduction in the presence of glucose-6-phosphate dehydrogenase and phosphohexoisomerase. Galactose was found to have no inhibitory effect whatsoever upon either tumor hexokinase. Galactose and fructose must therefore compete for a site prior to the hexokinase step in both Ehrlich and Gardner ascites tumor cells.

In Ehrlich cells glucolysis and fructolysis proceeded at equal rates and in homogenates glucolysis and fructolysis proceeded at approximately the same rate as in intact cells. In lymphosarcoma cells, however, at equimolar substrate concentrations the rate of glucolysis was far higher than fructolysis and the rate of glycolysis in intact cells could be increased by raising the level of either substrate. Fructolysis could proceed at a rapid rate, approaching that of glucolysis, when the extracellular concentration of fructose was above 0.1 molar. In lymphosarcoma homogenates the rate of glycolysis equaled or exceeded the rate in intact cells, glucose and fructose were utilized at approximately equal rates and the concentration of substrate, in the range of comparison, had no effect upon the rate of glycolysis. The rate of glycolysis in lymphosarcoma cells is therefore limited by a specific transport barrier. The Lineweaver-Burk plot demonstrated competition between galactose and fructose for the rate-limiting step. Therefore a reaction step prior to the hexokinase reaction is required for the transport of fructose into ascites tumor cells. This step is specifically and competitively inhibited by galactose. A model of the monosaccharide transport mechanism was proposed.

Additional studies with 2-deoxyglucose, a potent inhibitor of glucolysis, demonstrated that 2-deoxyglucose-6-phosphate is formed and is an effective inhibitor of phosphohexoisomerase and of another reaction subsequent to the formation of fructose-1,6-diphosphate.
132 pages. $2.00.

THE INFLUENCE OF TYPE OF ACTIVATION ON THE FATTY ACIDS RESULTING FROM MILK LIPASE ACTION

(L. C. Card No. Mic 58-1138)

Philip W. Rivers, Ph.D.
University of Minnesota, 1957

The object of the research was to attempt to analyze quantitatively for the individual fatty acids resulting from the action of milk lipase(s) on butterfat and to determine if differences in end products resulted when different means of enzyme activation were employed to induce rancidity in milk. Some trials, also, were performed to show the influence of the type and degree of rancidity on starter activity.

A technique was developed which permitted the concentration of free fatty acids from rancid milks. This involved a preliminary extraction of fatty acids from milk using a buffered silica gel column which retained all milk constituents except the glycerides and free fatty acids which were contained in the 5% butanol in chloroform eluate. The free fatty acids were then adsorbed on amberlite IR-45 resin from which they were eluted as their sodium soaps. After being concentrated, the individual fatty acids were determined quantitatively by the Tiselius-Claesson interferometric adsorption analysis apparatus using carrier displacement chromatography.

Subsequently, comparisons were made on the free fatty acid end products of milks in which rancidity had been induced by different activation techniques. The influences of mode of activation, individual differences among cows, conditions of incubation and physical structure of substrate were evaluated.

The mode of activation of lipase influenced the type and quantity of fatty acids liberated in rancid milk. During the initial stages of lipolysis, agitation activation resulted in the appearance of fatty acids ranging in chain length from butyric to stearic. On the other hand, spontaneously rancid milk and temperature activated milk did not contain any detectable butyric acid until after prolonged incubation. Variations in end products liberated by milk lipase action could also be caused by varying the conditions of incubation and physical properties of the substrate.

Starter cultures propagated in rancid milks varied in their ability to produce acid according to the method of activation of the enzyme and decreased in their ability to produce acid with increase and extent rancidity development.
88 pages. $2.00.

THE INTRACELLULAR SYNTHESIS AND MATURATION OF A VIRAL PRECURSOR

(L. C. Card No. Mic 58-1474)

Bernard William Uhlendorf, Ph.D.
University of Michigan, 1957

This dissertation concerns a detailed investigation of the kinetics of growth of influenza virus. Emphasis was placed on a study of the synthetic processes occurring in the infected host cell.

The host-virus system employed for this work was the PR8 strain of type A influenza virus and the chorio-allantoic membrane of the developing chicken egg suspended in a simple maintenance medium contained in a small flask. The experimental procedure was that of following the release of virus from and production of virus in the cells of the chorio-allantoic membrane. This was done by assaying the suspending medium and extracts of the membrane for hemagglutinating activity. The effect which the addition of the amino acid analog,p-fluorophenylalanine, and treatment with specific anti-viral immune serum at various times after the initiation of infection has on the production of virus was determined.

The following results were obtained: (1) exposure of the chorio-allantoic membrane to $10^{8.68}$ egg infectious doses of virus for fifteen minutes or less is sufficient to infect all the entodermal cells of the membrane and produce a single cycle of infection. (2) The rate of release of virus from the membrane is constant from 3 1/2 to 12 hours after initiation of infection. (3) The rate of production of virus in the cells of the membrane is constant from 3 1/2 to 9 1/2 hours and twice the rate of release of virus. (4) Although the production of virus is complete by 10 hours, only 85 per cent has been released by 24 hours. (5) p-Fluorophenylalanine produces complete inhibition of viral production when added before two hours after initiation of infection, no inhibition when added after ten hours, and partial inhibition when added between these times. (6) Treatment of the infected membrane with specific anti-viral immune serum for fifteen minutes at any time after initiation of infection until two hours afterward produces no suppression of subsequent viral yield, and treatment after ten hours produces complete suppression. Between these times, this treatment produces a greater suppression of subsequent viral yield than can be accounted for by the neutralization of pre-emergent virus. (7) The combined treatment with p-fluorophenylalanine and immune serum at any time after initiation of infection results in the complete suppression of subsequent production of virus.

It was concluded that: (1) the rates of synthesis and release of virus are limited and these processes are occurring at their maximum rates. (2) The synthesis of viral protein can be completely inhibited at any time by a sufficient concentration of p-fluorophenylalanine. The virus produced in the presence of the maximal inhibitory level of the inhibitor arises from the maturation of a pool of non-hemagglutinating precursor protein. (3) Specific anti-viral antibodies present in immune serum are able to penetrate the infected host cells and neutralize pre-emergent virus as well as the non-hemagglutinating precursor protein. 128 pages. $2.00.

STRUCTURAL STUDIES ON SOYBEAN HEMAGGLUTININ

(L. C. Card No. Mic 58-1144)

Shohachi Wada, Ph.D.
University of Minnesota, 1957

Adviser: Max O. Schultze

Soybean hemagglutinin is a toxic protein which was originally found as a contaminant of the crude soybean trypsin inhibitor. It was isolated in a state of about 95% electrophoretic purity from commercial hexane-extracted soybean flour.

Almost nothing was known concerning either the mechanism by which soybean hemagglutinin causes the aggregation of red blood cells or of the structural features of this protein in relation to its biological activity. The present study was undertaken in order to determine the effect of chemical modifications on the hemagglutinating activity of the soybean hemagglutinin, and to investigate structural features through end group analyses.

This work was carried out with both crude soybean hemagglutinin of 95% electrophoretic purity and with more highly purified material prepared by chromatography on an anion-exchange cellulose column.

For chemical modification, acetic anhydride, carbobenzoxy chloride, 2,4-dinitrobenzenesulfonic acid, iodine, p-diazobenzenesulfonic acid were used. Results obtained from the use of acetic anhydride, carbobenzoxy chloride, and 2,4-dinitrobenzenesulfonic acid indicate that, as more ϵ -amino groups were blocked either by acetic anhydride or carbobenzoxy chloride, there was increased loss in hemagglutinating activity and toxicity. When the amount of acetic anhydride was reduced to 5.0% and the reaction with carbobenzoxy chloride was carried out at 13°C for 100 minutes, only the α-amino groups of the hemagglutinin was blocked to about 60%. However no appreciable loss in hemagglutinating activity or toxicity was observed. Therefore, it is reasonable to conclude that ϵ-amino groups are more important for biological activity.

The iodination and diazotization of phenolic groups were accompanied by partial loss of hemagglutinating activity and of toxicity. Therefore, it is evident that phenolic groups are also essential for hemagglutinating activity and for the toxicity of crude soybean hemagglutinin.

End-group analyses were carried out by using 2,4-dinitrofluorobenzene, phenylisothiocyanate, carboxypeptidase, anhydrous hydrazine, and ammonium thiocyanate. Results obtained by the 2,4-dinitrofluorobenzene and phenylisothiocyanate methods indicate that the soybean hemagglutinin contains at least two N-terminal alanine residues. In the case of C-terminal residue determination, however, the results obtained by carboxypeptidase were equivocal and difficult to reconcile with those of the N-terminal residue determination. After prolonged treatment of the purified soybean hemagglutinin with carboxypeptidase, about one mole of serine was liberated per mole of substrate. In addition, fractional molar quantities of aspartic acid, glutamic acid, threonine, alanine, valine, leucine, isoleucine, glycine, proline, phenylalanine, tyrosine, lysine, and cystine were found. No conclusive evidence was obtained concerning the origin of these compounds.

It is concluded, therefore, that the most highly purified specimen of soybean hemagglutinin available for this study either (1) contains traces of amino acids or peptides which

render the interpretation of end-group analyses extremely difficult or (2) possesses a molecular structure which is unusually complicated. Neither possibility can be excluded from the present study. 128 pages. $2.00.

CHEMISTRY, INORGANIC

SOME AMINE AND PHOSPHINE COMPLEXES OF CHROMIUM(II) AND CHROMIUM(III)

(L. C. Card No. Mic 58-882)

David Alvin Berman, Ph.D.
University of Michigan, 1957

According to earlier literature reports, the oxidation of chromium(II) solutions in the presence of nitrogen complexing agents produces both hexamminechromium(III) salts and undesirable red oils by competing reactions. Reported results were erratic. In this study it has been found that active platinum serves as a catalyst to give almost quantitative yields of the desired hexammine when ammonia, ethylenediamine or propylenediamine is the nitrogen base. Yellow solutions indicative of hexammine formation were formed with triethylenetetramine and tetraethylenepentamine. The catalytic activity of other metals falls in the order: Pt $\gg$ Cu, Fe $>$ Ag, Au $\ggg$ Zn, Hg.

Methylamine, trimethylamine and trimethylenediamine formed chromium(III) hydroxide rather than hexammine complexes. Hydroxylamine gave chromium(III) hydroxide with variable amounts of coordinated hydroxylamine. A new double salt of chromium(III) was prepared; the formula $[Cr(NH_2OH)_5H_2O]Cl_3 \cdot 2NH_3OHCl \cdot 2H_2O$, has been assigned.

The complexing ability of a previously neglected series, the alkylphosphines, was compared with the complexing ability of the amines. The systems anhydrous chromium(II) chloride-methylphosphines were studied by means of the solid-vapor equilibria. The trend in ability to form stable complexes was found to be trimethylphosphine $>$ dimethylphosphine $>$ methylphosphine $>$ phosphine. This order is the reverse of that found with the amines.

At 0° phosphine did not react with chromium(II) chloride, methylphosphine gave $CrCl_2 \cdot 0.5MeH_2P$ and dimethylphosphine gave $CrCl_2 \cdot 4Me_2HP$. On heating, the methylphosphine underwent reversible thermal decomposition to give active $CrCl_2$; the dimethylphosphine adduct decomposed reversibly to give $CrCl_2 \cdot Me_2HP$, and the latter complex decomposed irreversibly to give unidentified products. None of the above phosphines would interact with anhydrous $CrCl_2$ at 25°C.

Trimethylphosphine, as expected, formed the most stable complexes of this series. At 25° compounds containing 1, 2.5 and 3 moles trimethylphosphine per mole chromium chloride were found. The 1:1 adduct was very stable and showed a magnetic moment which was the same as the chromium(II) ion. This compound, as that with the dimethylphosphine, was decomposed irreversibly by heat.
89 pages. $2.00.

AN INVESTIGATION OF AQUEOUS BINARY SALT MIXTURES OF THORIUM CHLORIDE WITH CHLORIDES OF LITHIUM, SODIUM, AND POTASSIUM

(L. C. Card No. Mic 58 1261)

Paul Merwyn Duell, Ph.D.
Kansas State College, 1958

Although the literature concerning thorium is extensive, the behavior of thorium salts in aqueous salt mixtures has received relatively little attention. The systems chosen for this investigation were binary salt mixtures of thorium chloride with chlorides of lithium, sodium, and potassium in aqueous solutions.

For each system a series of solutions were prepared which contained a constant concentration of alkali metal chloride (0.952 M) and varying concentrations of thorium chloride (up to 1.047 M). Solution properties investigated included diamagnetic susceptibility, partial molal volume, specific conductance, relative viscosity.

When specific susceptibility was plotted against weight per cent of thorium chloride in the mixtures, deviations from linearity were observed in the $LiCl-ThCl_4-H_2O$ and $NaCl-ThCl_4-H_2O$ systems. These deviations were taken as evidence for the formation of complex structures involving the hydrated cations and the chloride ion. The observed deviations occurred at the following stoichiometric points: $5LiCl.ThCl_4$, $4LiCl.ThCl_4$, $3LiCl.ThCl_4$, $LiCl.ThCl_4$, $5NaCl.ThCl_4$, $2NaCl.ThCl_4$. A slight deviation was indicated for $2KCl.ThCl_4$.

The observed departures from additivity of diamagnetic susceptibilities was discussed in terms of partial dehydration of the cations during the formation of complex structures. The change in partial molal volume with thorium chloride concentration was supporting evidence for such complex formation. Calculation of apparent susceptibilities of dissolved thorium chloride showed increases at most of the stoichiometric points indicated above. Increases in the apparent susceptibility of thorium chloride were explained in terms of the increase in susceptibility of water molecules as they were displaced from the strong electrostatic fields of the cations. The more pronounced effects in the lithium chloride mixture was assumed to be a result of the greater polarizing power of the lithium ion as compared to other alkali metal cations.

Specific conductance and viscosity measurements produced evidence that when the thorium chloride concentration reached approximately 22 per cent by weight, interpenetration of ionic hydration spheres began to occur. Increasing the concentration of thorium chloride beyond this value caused a decrease in conductivity in each of the three systems. The rate of increase of viscosity became greater in this area. 91 pages. $2.00.

MASS-YIELD DISTRIBUTIONS OF THE FISSION FRAGMENTS FROM PARTICLE-INDUCED FISSION OF Ra^{226}

(L. C. Card No. Mic 58-1083)

Reilly Campbell Jensen, Ph.D.
University of Washington, 1957

The fission of Ra^{226} by 9 and 11 Mev protons, by 22 Mev deuterons, and by 23.5 and 43 Mev helium ions has been studied using radiochemical techniques. The mass-yield curve of 11 Mev proton-induced fission shows three humps: a narrow hump centered about mass 112, corresponding to a symmetric fission mode, with two humps on either side, corresponding to an asymmetric fission mode. The measured fission yields of fission fragments at the peaks of all three humps are about the same. The heavy fragment "wing" of the asymmetric portion of the mass-yield curve is very similar in position and shape to the corresponding member of other asymmetric mass-yield curves. The light fragment wing has accordingly shifted to lower mass numbers, continuing the trend observed in the asymmetric fission-yield curves of elements heavier than radium. The central, symmetric-fission hump is of the same width as the narrow, symmetric fission curve observed for fission of bismuth by 20 Mev deuterons. The mass-yield curve of deuteron-induced fission appears to be a single symmetric distribution which is wider than the symmetric fission portion of the curve for proton-induced fission. The mass-yield curve of helium ion-induced fission follows the general trend of the heavier fissioning elements in showing an asymmetric distribution at low energies with a filling in of the symmetric valley as the excitation energy is increased. The cross section for fission of Ra^{226} by 11 Mev protons is measured to be 2.0 millibarns; by 9 Mev protons to be .03 millibarns; by 22 Mev deuterons to be 60 millibarns; by 23.5 Mev helium ions to be 7 millibarns; and by 43 Mev helium ions to be 250 millibarns. An analysis of this and other fission studies indicates that asymmetric fission is to be associated with low excitation energies and that in the region of radium the fission barrier is such that the excitation energy required to observe fission is high enough to greatly reduce the probability of asymmetric fission in comparison with symmetric fission. The analysis also shows that the probability of symmetric fission increases rapidly with the excitation energy of the fissioning nucleus, reaching values of the order of 0.5 for excitation energies of 40 Mev for elements heavier than thorium. 180 pages. $2.40.

SPECTROMETRIC STUDIES OF SOME ALCOHOL, HYDROXY AND ETHER COMPLEXES OF QUADRIVALENT CERIUM

(L. C. Card No. Mic 58-1300)

Harry Girard Offner, Ph.D.
Stanford University, 1958

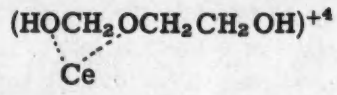
The reactions of quadrivalent cerium with certain compounds containing unshared electron pairs, and thus capable of forming complex molecules via electrostatic bonding, form the subject of this paper. In particular, the reactions with water to form hydrolyzed species, and with various alcohols, and the ether, veratrole, to form red-colored complex ions, were studied. It was the purpose of this investigation to determine the equilibrium constants of the various reactions, and the chemical constitution of the complexes formed. The experimental method used was the measurement of the absorbance of various solutions containing quadrivalent cerium and the organic compound. Equations were developed from which the experimental data could be translated into the desired information. The calculations were based on the differences in the molar extinction coefficients of the reactants and the products of the equilibria studied.

In the case of the hydrolysis study, it was found that, in the acid concentration range from 0.1 to 1.7 molar, there was one predominant reaction involving two species of the quadrivalent cerium. On the basis of this investigation, and also previous work reported in the literature,[1] it was decided that the most probable reaction was $Ce(OH)^{+++} + H_2O = Ce(OH)_2^{++} + H^+$. The observed equilibrium constant, which is independent of any postulated reaction, was calculated to be 0.20 ± 0.02, at 25^0 C. This constant was found to be more or less independent of the ionic strength at values of 0.91 or higher, but at an ionic strength of 0.53, the value of the constant was 0.25, indicating some effect of ionic strength on the activity of the reactants. The equilibrium constant was also determined at 5^0 C. to be 0.11, and from these two values the standard heat, $\Delta H^0_{t,p}$, of the hydrolysis reaction was calculated as 4.9 kilocalories/mole.

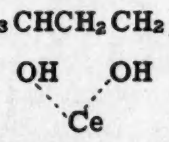
The alcohols, whose complexes with quadrivalent cerium were studied, were n-, sec-, and tert-butyl alcohols, diethylene glycol, and 1,3- and 1,4-butanediols. In each case, it was found that the colored complex was formed with one molecule of quadrivalent cerium combined with one molecule of the alcohol, over a wide range of both cerium and alcohol concentrations. Equilibrium constants were calculated for the complex forming reaction, for each alcohol, in both nitric and perchloric acid solutions. The values of these constants are shown in the following table.

Alcohol	Equilibrium Constants $HClO_4$ Solution	HNO_3 Solution
tert-Butyl alcohol	13	0.61
sec-Butyl alcohol	11	0.99
n-Butyl alcohol	16	0.90
Diethylene glycol	40	3.2
1,3-Butanediol	30	3.1
1,4-Butanediol	14	2.6

The values found from experiments in $HClO_4$ solutions must be considered only as order of magnitude values, because rapid oxidation of the alcohols during the absorbance measurements prevented accurate readings. These values were found to be considerably larger than those found from the experiments in nitric acid solutions, because of the extensive formation of ceric nitrate complexes in the latter case. Relatively high values of the equilibrium constants for the reactions involving diethylene glycol and 1,3-butanediol, indicating more stable complexes, suggested the presence of a chelated structure in these complexes, as shown below:



and



The complex of quadrivalent cerium with veratrole (1, 2-dimethoxy benzene) was studied in a sulfuric acid solution, as the complex is rapidly oxidized when either nitric or perchloric acid solutions are used. For this reason, the observed equilibrium constant of this reaction, which was 490, cannot be compared with those for the alcohol reactions, as stable ceric sulfate complexes are formed. However, it can be concluded from the results, that the veratrole complex is considerably more stable than those of any of the alcohols studied. Here again, the configuration of the veratrole molecule is favorable for the formation of a chelated structure, and the results indicate this to be the case. 143 pages. $2.00.

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THE "DIAMMONIATE OF DIBORANE" AND RELATED SUBSTANCES: REACTIONS WITH SODIUM IN LIQUID AMMONIA AND REACTIONS IN ETHER SLURRIES

(L. C. Card No. Mic 58-990)

Sheldon Gerald Shore, Ph.D.
University of Michigan, 1957

In essence this investigation represents a survey of the reactions of the protonic and hydridic hydrogens of the "diammoniate of diborane," which has been shown to be a borohydride-type compound, $[H_2B(NH_3)_2]^+[BH_4]^-$, by the members of this laboratory. The "diammoniate of diborane" reacts with sodium in liquid ammonia to produce one equivalent of hydrogen gas per mole of compound in a short period of time. Traces of additional hydrogen are given off over an extended period of time. Using this reaction with sodium as a criterion for authenticity, conditions for preparing samples of the "diammoniate" were examined, and the possible products which might be formed by deviating from these conditions were considered.

The "diammoniate of diborane" was prepared and isolated through the slow, low temperature addition of diborane to solid ammonia, followed by the removal of excess ammonia by sublimation. However, if the excess ammonia was never removed from the system, and if heating effects were avoided during the addition of diborane to ammonia, the resulting material reacted much more slowly with sodium in liquid ammonia than the "diammoniate." Taking into account previous observations of related systems, it is believed that the material obtained in the second case is a solution of diborane in ammonia, or perhaps a coordination compound in which only one hydrogen-bridged bond of diborane exists, $H_2B(NH_3)H\text{-}BH_3$.

If diborane and ammonia are allowed to react rapidly and vigorously with each other, or if ammonia solutions of the authentic "diammoniate" are handled under relatively severe conditions, the resulting product, in both cases, reacts with sodium in liquid ammonia to produce around 1.3 equivalents of hydrogen per mole of diborane. The stoichiometry of the reaction suggests that this new material is $[HB(NH_3)_3]^{+2}([BH_4]^-)_2$.

Tracer studies, using deuterium as a tracer, showed that the reactions with sodium in liquid ammonia of the materials cited above take place through the exclusive or near exclusive rupture of nitrogen-hydrogen bonds. The work was complicated by an isotope effect, but the results were consistent with the structural formulations of the materials examined.

A new compound ammonia-borane, H_3NBH_3, was prepared through the reaction between an ammonium salt and a borohydride salt in an ether slurry.

$$NH_4X + MBH_4 \longrightarrow H_3NBH_3 + H_2 + MX$$

It was characterized and shown to be entirely different from the "diammoniate of diborane." The discovery of ammonia-borane resolves controversy over the existence of such a compound. Thus there appears to be a series of possible coordination compounds of the same empirical formula, $(H_3NBH_3)_m$, differing by successive replacement of hydridic hydrogen by ammonia.

$$H_3NBH_3\ ,\ [H_2B(NH_3)_2]^+[BH_4]^-\ ,\ [HB(NH_3)_3]^{+2}([BH_4]^-)_2$$

Ammonia-borane was also prepared from the "diammoniate of diborane" through its reaction with ammonium chloride in an ether slurry and through its decomposition in the presence of the strongly polarizing lithium (I) in lithium chloride and lithium bromide. Both reactions parallel the equation above in that hydrogen is split out due to the in interaction between hydridic hydrogen which is bound to boron and protonic hydrogen which is bound to nitrogen. These studies provide additional evidence for the borohydride formulation of the "diammoniate." Attempts to produce similar observations from aluminum chloride and the "diammoniate" in an ether slurry resulted in hydride-chloride interchange. The principal products were aluminum hydride etherate and boron trichloride etherate. 146 pages. $2.00.

SOLID-VAPOR EQUILIBRIA IN THE IRON-CHLORINE AND IRON-CHLORINE-BROMINE SYSTEMS

(L. C. Card No. Mic 58-1100)

Laurence Edward Wilson, Ph.D.
University of Washington, 1957

The reaction between chlorine and solid iron(II) chloride at temperatures between 164 and 425°C has been investigated by gas saturation flow experiments, as has the thermal decomposition of solid iron(III) chloride between 129 and 227°C. In addition, measurements have been made of the total static pressures that exist at equilibrium over solid iron(III) chloride. The results of these investigations have given the logarithms of the equilibrium constants for the three following reactions as linear functions of reciprocal temperature.

II. $2FeCl_2(s) + Cl_2(g) = Fe_2Cl_6(g)$

III. $2FeCl_3(s) = 2FeCl_2(s) + Cl_2(g)$

IV. $2FeCl_3(s) = Fe_2Cl_6(g)$

Mean standard heats of reaction and mean standard entrophies of reaction have been calculated from the constants obtained by least squares analysis for the linear log K vs. 1/T equations. These data are summarized as follows:

Reaction	Mean Temp. °K	$\triangle H^0$ kcal.	$\triangle s^0$ cal./deg.
II.	575	6.44	16.98
III.	519	25.5	37.5
IV.	519	32.68	55.97

The results thus obtained have been compared to the information presently available in the technical literature, and fair agreement has been found with the results obtained by Schafer and Oehler on reaction III, while poor agreement has been obtained with other workers who have studied these equilibria.

Flow experiments have been conducted in which bromine gas has been passed over solid solutions of $FeCl_2$ and $FeBr_2$. Analysis of materials condensed from the gas exiting from the reactor has given definite evidence for the existence of one or more iron(III) halides having a stoichiometry intermediate to iron(III) chloride and bromide.

104 pages. $2.00.

CHEMISTRY, ORGANIC

TETRAHYDROFURFURALDEHYDE AND RELATED COMPOUNDS

(Publication No. 25,426)

Albert Cornelius Antoine, Ph.D.
The Ohio State University, 1953

Several, varied attempts have been made to prepare tetrahydrofurfuraldehyde. In most instances, the yields were quite unsatisfactory. Among the methods used were the reduction of the furan ring of furfuraldehyde,[1] and the reduction of the furan ring of the diethyl acetal and diacetate derivatives of furfuraldehyde, followed by hydrolysis of the reduced acetal and acetate.[1,2,3] Oxidation of tetrahydrofurfuryl alcohol with chromium trioxide and also dehydrogenation with a copper catalyst were attempted,[3] but afforded only poor yields of the aldehyde.

The most successful method to date is that of Bremner and his associates.[4] They claimed a sixty per cent yield of tetrahydrofurfuraldehyde by the oxidation of tetrahydrofurfuryl alcohol. The reaction was carried out in the vapor phase by passing a mixture of alcohol, water, and air over a silver-gauze catalyst.

I have applied four new methods of synthesis in attempting to obtain good yields of the aldehyde. They were the McFadyen-Stevens reaction,[5] the Rosenmund reaction,[6] a hydrogen exchange reaction,[7] and the reduction of tetrahydrofuroyl chloride with sodium trimethoxyborohydride.[8] None of the four proved satisfactory as a method of synthesis.

Tetrahydrofurfuraldehyde was investigated as the probable intermediate in the vapor phase side chain elimination reaction of tetrahydrofurfuryl alcohol,[9] and was found to behave as anticipated. When passed over a 80Ni, 20Cu catalyst it yielded dihydrofuran and tetrahydrofuran in percentages and amounts comparable to those obtained using tetrahydrofurfuryl alcohol.

δ-valerolactone, an isomer of tetrahydrofurfuraldehyde, was one of the products observed when tetrahydrofurfuryl alcohol was passed over metallic catalysts at elevated temperatures.[10,11,12] This product was observed in particular with catalysts of high copper content, suggesting a dehydrogenation of the alcohol and subsequent rearrangement of the aldehyde produced. Therefore, several attempts were made to rearrange the aldehyde. It was refluxed in ethyl alcohol and in n-pentanol, with mercuric chloride as catalyst, but no lactone was observed among the products. Reacting the aldehyde in the vapor phase with acid-saturated pumice or refluxing in ether with phosphorus pentachloride also induced no rearrangement.

The question of the formation of δ-valerolactone from tetrahydrofurfuryl alcohol was further pursued, attention being given to other proposed intermediates. It was known that tetrahydrofurfuryl alcohol could be hydrogenated to 1,5-pentanediol,[13,14] and also that this diol yielded δ-valerolactone when reacted in the same manner as tetrahydrofurfuryl alcohol.[15] The dehydrogenation products of 1,5-pentanediol, δ-hydroxyvaleraldehyde, and glutaraldehyde, were investigated as immediate predecessors of δ-valerolactone. Glutaraldehyde was passed over copper chromite in the temperature range 250-350°, but was entirely decomposed or polymerized. The behaviour of δ-hydroxyvaleraldehyde was studied over a 80Ni, 20Cu, a 90Cu, 10Fe, and a copper chromite catalyst in the same temperature range. The products obtained from the 80Ni, 20 Cu catalyst were dihydropyran (with some tetrahydropyran) and n-valeric acid. From the other two catalysts, pyrans, n-valeric acid, and δ-valerolactone were obtained. The best yields of the lactone were obtained using the copper chromite catalyst. The results obtained were quite similar to those observed when pentanediol was reacted in a like manner.[15]

One further possibility for lactone formation was the dehydration and rearrangement of tetrahydrofurfuryl alcohol to dihydropyran,[16,17] followed by the addition of water, forming δ-hydroxyvaleraldehyde, and then the latter's dehydrogenation. Experiments showed that this scheme was unlikely, since very little addition took place when water and dihydropyran were passed simultaneously over a 90Cu, 10Fe catalyst.

The conclusion drawn, therefore, was that δ-valerolactone was formed from tetrahydrofurfuryl alcohol by reductive fission of the alcohol to 1,5-pentanediol, followed by successive dehydrogenations to δ-hydroxyvaleraldehyde and δ-valerolactone.

64 pages. $2.00. Mic 58-4788

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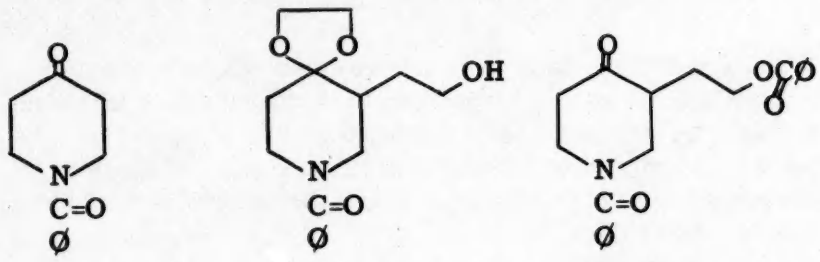
Abstract published by special arrangement with The Ohio State University.

STUDIES TOWARD THE TOTAL SYNTHESIS OF CINCHONAMINE

(L. C. Card No. Mic 58-1330)

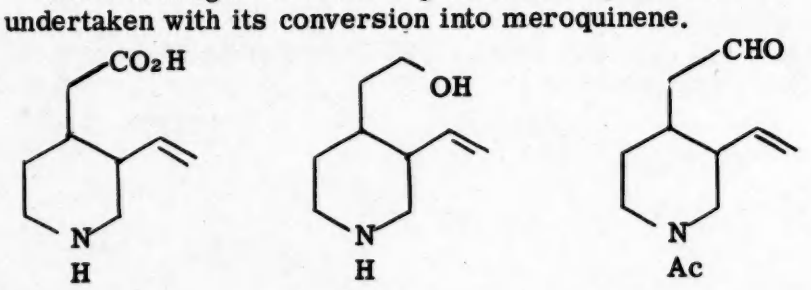
Robert L. Augustine, Ph.D.
Columbia University, 1957

Various paths to the synthesis of a useful intermediate for the preparation of meroquinene (IV) were investigated. The intermediate, 1-benzoyl-3-(2-benzoyloxyethyl)-4-piperidone (III) was synthesized through the alkylation of the pyrrolidine enamine of 1-benzoyl-4-piperidone (I) with ethyl bromoacetate, preparation of the ethylene glycol ketal of the product and reduction of the ester with lithium borohydride to the alcohol, 1-benzoyl-3-(2-hydroxyethyl)-4,4-ethylenedioxy piperidine (II). Benzoylation of the alcohol followed by hydrolysis of the ketal gave III.



I II III

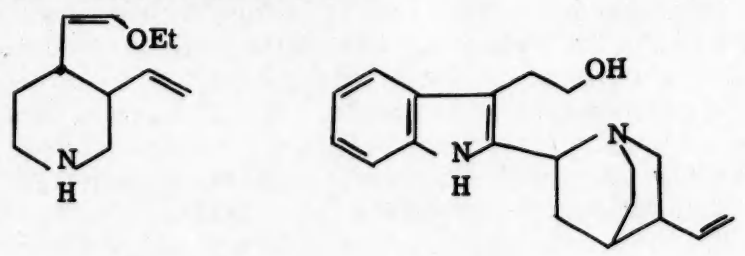
A reinvestigation of the degradation of quinine was also undertaken with its conversion into meroquinene.



IV V VI

Meroquinene was then transformed into 3-vinyl-4-(2-ethoxyvinyl) piperidine (VII). The sequence used was reduction of IV with lithium aluminum hydride to 3-vinyl-4-2-hydroxyethyl) -piperidine (V), acetylation of the nitrogen and oxidation with chromium trioxide in pyridine to the aldehyde, 1-acetyl-3-vinyl-4-piperidyl acetaldehyde (VI), preparation of the enol-ether and base hydrolysis of the amide to give VII.

Attempts at the condensation of VII with tryptophol to give cinchonamine (VIII) under a variety of conditions have so far remained unsuccessful.



VII VIII

116 pages. $2.00.

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PERHALOGENATED ORGANIC FLUORIDES WITH OXYGEN FUNCTIONS

(Publication No. 25,435)

Frank Peter Avonda, Ph.D.
The Ohio State University, 1953

General Aims

The broad plan of the work is to search for means of synthesis of perfluorinated compounds with an oxygenated function so that the alteration of the conventional oxygenated function by the neighboring fluorine atoms can be observed.

The present work is concerned with these syntheses, to which the following approach is tried: starting from a partly fluorinated functional compound such as CF_3COCH_3,

$$CF_3COCH_3 \longrightarrow CF_3COCX_3 \longrightarrow CF_3COCF_3$$

The same two step study is applied to other functional derivatives, i.e., CF_3COCH_2COOEt, $CF_3COCH_2COCF_3$, $CF_3COCH_2CF_3$, $CF_3CO\text{-}O\text{-}CH_3$.

Both steps present entirely new problems; if that had not been the case, the commercially desirable CF_3COOH would have been prepared a long time ago by halogen exchange on commercial CCl_3COOH or CCl_3CHO.[1] Obviously halogens adjacent to an oxygenated function are not conventional; they are even less so when adjacent to an oxygenated function which is already modified by a fluorinated group.

A specific object of part of this work is the selection, if possible, of the more practical route in each of the following sets of reactions.

a) $CF_3COCH_2COOEt \longrightarrow CF_3COCBr_2COOEt \longrightarrow CF_3COCHBr_2 \longrightarrow CF_3COCBr_3$

b) $CF_3COCH_2COOEt \longrightarrow CF_3COCH_3 \longrightarrow CF_3COCBr_3$

a) $CF_3COCH_2COOEt \longrightarrow CF_3COCBr_2COOEt \longrightarrow CF_3COCF_2COOEt \longrightarrow CF_3COCHF_2$

b) $CF_3COCH_2COOEt \longrightarrow CF_3COCBr_3 \longrightarrow \boxed{CF_3COCF_3} \longleftarrow CF_3COCBrF_2$

It was also interesting to investigate the possibility of isolating CF_3OH from $CF_3CO\text{-}O\text{-}CF_3$, with the idea of showing that CF_3OH is not an alcohol but a new function akin to an ortho acid.

PART ONE

Although CF_3COCH_2COOEt has been known for sometime, halogenation of it has not been studied until recently, Hill et al.[2] synthesized $CF_3COCHClCOOEt$ by direct chlorination of ethyl trifluoroacetoacetate, Mentcher[4] synthesized $CF_3COCHBrCOOEt$ in 89.9 per cent yield by brominating the copper chelate of CF_3COCH_2COOEt in $CHCl_3$. Henne and Mentcher[3,4] obtained an impure dibrominated product by means of Br_2 in CH_3COOH with CH_3COONa. Co-incident with the present work, Mosby[5] claimed the isolation of pure CF_3COCBr_2COOEt by using Br_2 with pyridine, but their best yield was only 34 per cent.

A pure dibrominated product could not be obtained by following the method of Henne and Mentcher[3] using an aqueous working-up of the product; the method was successful, however, when water was eliminated from the procedure. The main contaminant arising from the use of the original procedure was $CHBr_2COOEt$ produced by the cleavage of CF_3COCBr_2COOEt with H_2O. In the revised procedure a minimum yield of 48.1 per cent is obtained.

Brominations of CF_3COCH_2COOEt with Br_2 and pyridine in petroleum ether, and Br_2 with dry N_2 were also tried, but the methods were abandoned as impractical.

All of the above methods have the problem of HBr removal. This problem does not occur in the Wohl-Ziegler method of bromination[6] since there is no HBr produced. By this method, $CF_3COCHBrCOOEt$ and CF_3COCBr_2COOEt were prepared in yields of 63.5 per cent and 88.8 per cent respectively with the use of N-bromosuccinimide (N.B.S.) and CCl_4. This is the first time a successful dibromination of this type has been run in the absence of strong light. In the above brominated compounds, the bromine is positive in character and can be quantitatively titrated with KI solution.

Another method of bromination, the use of trifluoroacetoxyl bromide, $CF_3CO\text{-}O\text{-}Br$[7] showed promise but could not compete economically with the methods which employed cheaper reagents. The acid hydrolysis and decarboxylation of $CF_3COCHBrCOOEt$ are difficult but can lead to CF_3COCH_2Br. Schmitz[8] had difficulty in decarboxylating $CF_3COCHClCOOEt$ with 25 per cent H_2SO_4; he attributed this to the immiscibility of the reactants. He succeeded, however, by using an ester-interchange of the keto-ester with propanoic acid. Mentcher[4] hydrolyzed and decarboxylated $CF_3COCHBrCOOEt$ with 20 per cent H_2SO_4 to give CF_3COCH_2Br in 60 per cent yield. Hill et al.[2] hydrolyzed and decarboxylated $CF_3COCHClCOOEt$ with 30 per cent H_2SO_4.

With the dibromo derivative of CF_3COCH_2COOEt, however, hydrolysis was found to occur to only a negligible extent, and decarboxylation not at all. Therefore, CF_3COCBr_2COOEt is not a practical intermediate to $CF_3COCHBr_2$. The methods used were: Aqueous H_2SO_4, ester-interchange with CF_3COOH or CH_3COOH using concentrated H_2SO_4 as catalyst and concentrated HCl with CH_3COOH. Although it was doubtful whether any appreciable hydrolysis and decarboxylation occurred in the last mentioned method, perhaps, in view of the reported boiling point of $CF_3COCHBr_2$, B.P. 113.3-113.4°C.,[9] propanoic acid, B.P. 141.1°C. should be used in place of CH_3COOH, B.P. 118.1°C.

The difficulty in the hydrolysis of the brominated trifluoroacetoacetic esters is attributed to the inductive effect of the very electronegative $-CF_3$ group, and the steric effect of the large bromine atoms.

Basic hydrolysis would be more efficient but it obviously is not suited for the type of molecule dealt with here.

$CF_3COCH_2CF_3$ has never been successfully halogenated, until now. A successful dibromination of this compound was made using N.B.S. with nitrobenzene as solvent; CCl_4 with or without ultra-violet light was not successful in this case. The yield of $CF_3COCBr_2CF_3$ was 77.5 per cent.

The only halogenated derivative of $CF_3COCH_2COCF_3$ known previous to this work was $CF_3COCCl_2COCF_3$ prepared by Schmitz[8] using Cl_2 in diffuse light. He was unsuccessful in brominating $CF_3COCH_2COCF_3$ however.

Dibromination of $CF_3COCH_2COCF_3$ did succeed using N.B.S. with CCl_4, the yield was 65.4 per cent. In the monobromination of this compound under the same conditions, a clean product could not be obtained. It is recommended that nitrobenzene be used as a solvent rather than CCl_4.

The first successful direct halogenation of CF_3COCH_3 was made by Shepard[10] using neutral hypochlorite; he

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isolated $CF_3COCHCl_2$ in low yield. Later, Henne and Mentcher[3] obtained CF_3COCBr_3 by direct bromination of CF_3COCH_3 in CH_3COOH using CH_3COONa. McBee and Burton[9] synthesized CF_3COCH_2Br and $CF_3COCHBr_2$ in good yields by brominating CF_3COCH_3 in concentrated H_2SO_4 as solvent.

The monobromination of CF_3COCH_3 using N.B.S. in either Freon 113 or nitrobenzene failed, perhaps due to the low boiling point of CF_3COCH_3, 21.9°C., which prevented the attainment of a sufficiently high pot temperature. A sealed tube bromination is therefore recommended. CF_3COCBr_3 was prepared by the method of Henne and Mentcher[3] as developed by Pelley[11] in 60.5 per cent yield.

PART TWO

Experimental Search for New Fluorination Methods

In the past, the two generally accepted methods for producing complicated organic fluorides with oxygenated functions were:

a) Synthesis of the molecular structure from fundamental materials already containing the fluorine atoms desired

b) Creation of the desired oxygenated function after the fluorine atoms have been properly placed in the molecule.

The above routes were preferred to halogen exchange involving the complicated oxygenated organic halides and inorganic fluorides, because all replacement reactions of this latter type must be carried out under completely anhydrous conditions. The difficulty of removing the last traces of water from oxygenated compounds, and the possibility of producing water by decomposition, thus stopping the reaction or altering its course, account for the fact that it is often difficult to utilize halogen compounds which contain oxygen in the molecule.[1,12]

In recent times, some success was obtained by the action of elementary fluorine on oxygenated organic compounds.[13] However, this method is still in the pioneering stage due to the delicateness and inherent difficulty of direct fluorination of oxygenated organic compounds. In practice, only perfluorinated acids are made by direct fluorination.

A) Fluorination of CF_3COCBr – Type Compounds.

The following experiments were carried out with generally negative results:

I) Fluorination of CF_3COCBr_2COOEt in a bomb with KF·HF at elevated temperatures. No fluorinated product was obtained; decomposition occurred.

II) Fluorination of CF_3COCBr_2COOEt with KF·HF in CH_2OHCH_2OH at 160°C.

Some cleavage products were obtained, but the main product was FCH_2CH_2OH caused by solvent fluorination.

III) Fluorination of CF_3COCBr_2COOEt with KF· HF in CH_3COOH at reflux temperature of the solvent.

No clear isolatable fluorinated product was obtained.

IV) Fluorination of $EtOCOCBr_2COOEt$ with NaF at 180°C./23.5 mm.

The starting material was completely recovered.

V) Fluorination of $EtO\text{-}COCBr_2COOEt$

a) With HgF_2 at 135°C./12 mm

Some decomposition occurred, the greater part of the starting material was recovered.

b) With HgF_2 at 160°C./10 mm

Some decomposition occurred, a small amount of a relatively low boiler was obtained, but the greater part of the starting material was recovered.

VI) Fluorination of CF_3COCBr_3 with AgF in CH_3CN using a bomb at elevated temperatures.

a) Aqueous working-up

Significant fluorination of the solvent occurred. No starting material was recovered, it must have been lost through decomposition and hydration with the ice water.

b) Non-aqueous working-up

Very little fluorination of the solvent occurred. The contents were distilled from the bomb at 140°C./3 mm., the gases being caught in dry ice-acetone and liquid N_2 traps. Only a small amount of a low boiler was obtained. No starting material was recovered.

The poor results in these fluorinations must be considered in the light of the following observations.

i) The above compounds have a very positive bromine atom in their structures, the cause of this situation usually being the very powerful electronegative CF_3CO- group.

ii) Since the fluorine atom is the most electronegative atom known, the likelihood of replacing an extremely positive bromine with an extremely negative fluorine atom in an ionic reaction is poor indeed. A reaction involving a free-radical mechanism is not likely because of the large electrostatic forces in the molecule.

iii) The approach of a negative fragment would be immediately slowed down by the predominantly negative charges on the surface of the molecule.

B) Fluorination of $CF_3CO\text{-}O\text{-}CCl_3$

The following experiments were carried out unsuccessfully.

I) Use of 100 per cent SbF_3Cl_2, in a bomb at room temperature. The reagents were added to the bomb which was set in dry ice. The gaseous product was purified by sealing it with water in a Carius tube. The sole product thus obtained was CF_2Cl_2.

II) Use of HgF_2 at 49°C. The reagents were added to the flask which was set in dry ice.

The major gaseous product had a high chlorine content and probably was either $COCl_2$, $CHCl_2F$, or both.

III) Use of HgF_2 with $CHCl_3$ at the reflux temperature of $CHCl_3$. The reagents were added as in II).

The major product was similar to that obtained in II).

If the compound CF_3OH could be made, it would certainly not be of the alcohol type; rather it would have the properties of an acid. The perfluorinated methyl acetate would then take on the aspect of an anhydride:

$$CF_3OH + CF_3COOH \xrightarrow{-H_2O} CF_3COOCF_3$$

in which case, it would be very unstable in the presence of water. No one has as yet isolated CF_3OH, probably because of its instability; there is definite evidence, supporting this conclusion, in the literature.[14,15,16,17]

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Summary of Principal Results and Conclusions

I) The bromination of a $>CH_2$ or $-CH_3$ group adjacent to one or two CF_3CO- groups has been systematically studied, and a procedure using N-bromosuccinimide in CCl_4 has been found the most practical. It is imperative to work up the reaction products in a non-aqueous medium.

II) CF_3COCH_2COOEt has been successfully transformed to $CF_3COCHBrCOOEt$ and CF_3COCBr_2COOEt. This is the first time a dibromination of this type, using N-bromosuccinimide and CCl_4, has been run in the absence of a strong light. The acid hydrolysis and decarboxylation of the monobromo-derivative are difficult but can lead to CF_3COCH_2Br.

Hydrolysis was found to occur to only a negligible extent and decarboxylation not at all in the dibromo- derivative, which is therefore not a practical intermediate to $CF_3COCHBr_2$.

III) $CF_3COCH_2CF_3$ has been brominated to $CF_3COCBr_2CF_3$, but the bromination had to be carried out in nitrobenzene instead of CCl_4.

IV) $CF_3COCH_2COCF_3$ has been transformed into $CF_3COCBr_2COCF_3$.

V) CF_3COCH_3 has been brominated to CF_3COCBr_3 by using Br_2 in the presence of CH_3COONa with CH_3COOH.

VI) In $CF_3COCHBrCOOEt$, CF_3COCBr_2COOEt, $CF_3COCBr_2COCF_3$ and CF_3COCBr_3, the bromine is positive in character and can be quantitatively titrated with KI solution.

VII) Efforts to substitute these positive halogens by fluorine have failed with a variety of combinations of KF·HF in various solvents or dispersing agents. Some mildly encouraging indications seem to be possible in the use of HgF_2 or AgF_2 which one could perhaps regard as $[HgF]^-F^+$ or $[AgF]^-F^+$ to a modest extent.

VIII) Fluorination of $CF_3CO-O-CCl_3$ by conventional methods led to decomposition, with production of non-oxygenated fragments such as CF_2Cl_2. No progress was thus made toward $CF_3CO-O-CF_3$ and the hypothetical CF_3OH.

IX) For the production of perfluorinated derivatives containing an oxygenated function, one is thus thrown back to the method so far advocated in this laboratory, to introduce all fluorines first and create the oxygenated function only as a last step, as illustrated by the synthesis of perfluoro-acetone:[18]

$$CF_3 - \underset{CF_3}{\overset{|}{C}} = CCl_2 \xrightarrow{[O]} CF_3 - \overset{O}{\overset{\|}{C}} - CF_3$$

and the synthesis of perfluoro-malonic ester:[19,20]

$$\left.\begin{array}{l} CH_2 = CH - CF_2 - CH = CH_2 \\ CCl_2 = CCl - CF_2 - CCl = CCl_2 \end{array}\right) \xrightarrow[CH_2N_2]{[O]} CH_3OCOCF_2COOCH_3$$

X) Since metallic fluorides, like those of antimony and mercury, are not promising in the fluorination of oxygenated organic fluorides containing positive halogens, perhaps a solution to the problem would be the use of F_2 with HF in a controlled fluorination:

$$CF_3CO - \underset{\longleftarrow}{\overset{+\delta\ Br}{\overset{|}{\underset{|}{C}}}}{}^{-\delta}{}_{-\delta}{}^{\longrightarrow} - COOEt \xrightarrow[HF]{2(F^+F^-)} CF_3COCF_2COOEt + 2(Br^+F^-)$$
$$\qquad\qquad\qquad\qquad\quad +\delta\ Br$$

General Tabulation of Physical Constants

Compound	B.P. (°C.)	Index of Refraction	Reference (Literature reference given when possible.
CF_3COCH_3	21.7–21.9	———	(21)
CF_3COCH_2Cl	71.–72	$n_D^{20} = 1.3440$	(2)
$CF_3COCHCl_2$	101.8–102	$n_D^{20} = 1.3887$	(10)
CF_3COCCl_3	No Data		
CF_3COCH_2Br	86.6	$n_D^{20} = 1.3750$	(9)
$CF_3COCHBr_2$	113.3–113.4	$n_D^{20} = 1.4311$	(9)
CF_3COCBr_3	69.8–69.9/47 mm.	$n_D^{20} = 1.4785$	(9)
CF_3COCH_2COOEt	41–42/22 mm.	$n_D^{19.5} = 1.3783$	(22)
$CF_3COCHClCOOEt$	67–69/23 mm.	$n_D^{19.5} = 1.3890$	(2)
CF_3COCCl_2COOEt	No Data		
$CF_3COCHBrCOOEt$	65–67/11 mm.	$n_D^{20} = 1.4100$	(*)
CF_3COCBr_2COOEt	60–62/4 mm.	$n_D^{20} = 1.4372$	(*)
$CF_3COCH_2COCF_3$	69.8–69.9	$n_D^{20} = 1.338$	(8)
$CF_3COCHClCOCF_3$	No Data		
$CF_3COCCl_2COCF_3$	90–91	$n_D^{20} = 1.3533$	(8)
$CF_3COCHBrCOCF_3$	No Data		
$CF_3COCBr_2COCF_3$	82.5–83/172.5 mm.	$n_D^{20} = 1.3942$	(*)
$CF_3COCH_2CF_3$	54.2	$n_D^{20} = 1.282$	(23)
$CF_3COCHBrCF_3$	No Data		
$CF_3COCBr_2CF_3$	56.5–57.5/184 mm.	$n_D^{20} = 1.3829$	(*)
$CF_3COOCCl_3$	88–89.2	$n_D^{20} = 1.3712$	(*)

*This thesis

However half of the fluorine would be used up to form Br^+F^-, which would be wasteful.

112 pages. $2.00. Mic 58-4789

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Abstract published by special arrangement with The Ohio State University.

A STUDY OF THE COMPOSITION AND SOME REACTIONS OF THE ETHERATE OF ALUMINUM TRIETHYL

(Publication No. 25,430)

Evelyn Ruth Blust Baker, Ph.D.
The Ohio State University, 1953

Although many physical measurements have been made on aluminum triethyl, little work has been done on its reactions or on those of aluminum triethyl etherate.[1,2,3] Therefore, it was decided to investigate the reactions of aluminum triethyl etherate with some simple inorganic compounds.

The formula of the etherate has been given as $4Al(C_2H_5)_3 \cdot 3(C_2H_5)_2O$[4], but in terms of electronic structures, the formula $Al(C_2H_5)_3 \cdot (C_2H_5)_2O$ seems more probable. Therefore, it was decided to determine the composition of the etherate by a cryoscopic study of the system aluminum triethyl-diethyl ether, and by analysis of the etherate itself.

Phase Study of the Binary System Aluminum Triethyl-Diethyl Ether.

The phase study was carried out by the synthetic method. A Leeds and Northrup Micromax self-recording potentiometer with a copper-constantan thermocouple was used to measure the temperatures and to draw the cooling curves. A completely enclosed freezing point cell provided with magnetic stirring was used.

Aluminum triethyl was prepared, with pure aluminum, by a modification of the method of Grosse and Mavity.[5]

In the binary system aluminum triethyl-diethyl ether, the formation of a compound at 50 mole per cent diethyl ether is indicated. This compound was found to melt congruently at about -65°C., and to have the empirical composition $Al(C_2H_5)_3 \cdot (C_2H_5)_2O$. Eutectics were found at 34 mole per cent of ether and -71.0°C., and at 96 mole per cent of ether and -119.1°C.

Experimental difficulties in getting freezing points, owing to the reactivity of aluminum triethyl, the tendency for the mixtures to supercool, and the apparently low heats of fusion, were encountered. Because of these difficulties and the nearness of the eutectic temperature (-71°C.) to the freezing point (-65°C.) of the compound, there was still room for some small doubt concerning the 4:3 and 1:1 alternatives. In order to remove this doubt, aluminum triethyl etherate was prepared and distilled under vacuum into the cell, and its freezing point was determined. Known quantities of ether were added and the freezing points were again determined. The freezing point of the pure etherate (-64.0°C., and -64.5°C.) agrees well with the maximum in the freezing-point curve (-65°C.). Freezing points obtained after known quantities of ether had been added fit the curve closely if it is assumed that the etherate is a 1:1 compound. Finally, aluminum analyses on the pure etherate agree closely with the calculated value for the 1:1 compound. Found: (two preparations) 14.31 per cent Al, 14.46 per cent Al. Calculated for $Al(C_2H_5)_3 \cdot (C_2H_5)_2O$: 14.33 per cent Al.

Reaction of Aluminum Triethyl Etherate with Alkali Metal Alkyls.

In this research sodium aluminum tetraethyl was prepared from sodium ethyl and aluminum triethyl etherate, and lithium aluminum tetraethyl from lithium ethyl and aluminum triethyl etherate.

Sodium ethyl was prepared from mercury diethyl and sodium, with petroleum ether as a solvent. After the sodium ethyl had been formed, the aluminum triethyl etherate was added directly to the reaction mixture. The resulting solution was filtered, the solvents distilled off, and the solid product recrystallized from benzene. The resulting solid was weighed, hydrolyzed, and analyzed. Found: First preparation, 16.11 per cent Al, 13.89 per cent Na; Second preparation, 16.18 per cent Al, 14.02 per cent Na. Calculated for $NaAl(C_2H_5)_4$: 16.23 per cent Al, 13.84 per cent Na.

Sodium aluminum tetraethyl is a white, crystalline solid which reacts violently with water, decomposing to oxide and hydroxide with gas evolution. The compound is highly soluble in diethyl ether, much less soluble in benzene, and still less soluble in petroleum ether. It was found to melt, without sublimation, in a vacuum at about 125°C.

Lithium ethyl was prepared from the reaction of lithium metal with ethyl bromide in petroleum ether in a helium atmosphere. After the lithium ethyl had been made, aluminum triethyl etherate was added to the mixture. Benzene was also added, the petroleum ether distilled off, and the benzene solution filtered. On being cooled, the solution deposited white crystals. The mother liquor was filtered off, and the crystals washed, and then dried under vacuum. The compound was weighed, hydrolyzed, and analyzed. Found: First preparation, 17.42 per cent Al, 4.48 per cent Li; Second preparation, 17.42 per cent Al, 4.66 per cent Li; Third preparation, 17.86 per cent Al, 4.69

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per cent Li. Calculated for $LiAl(C_2H_5)_4$, 27.96 per cent Al, 4.62 per cent Li.

Lithium aluminum tetraethyl is a white solid, forming needle-like crystals, radiating from a central point, and appearing under the microscope as smooth, round rods. It is similar in properties and solubility to the sodium compound except that it melts with sublimation in a vacuum at about 160°C.

Reaction of Aluminum Triethyl Etherate with Sulfur Dioxide.

Dry sulfur dioxide was condensed on aluminum triethyl etherate. After evaporation of the excess sulfur dioxide and drying under vacuum, the white solid which resulted gave the following analysis: Aluminum (as Al_2O_3 residue on ignition), 8.72, 8.80, 9.02 per cent; Aluminum (as 8-hydroxyquinolate), 8.70 per cent; Sulfur, 31.51, 31.12 per cent; Carbon, 23.38, 23.42 per cent; Hydrogen, 4.99, 4.94 per cent. Calculated for aluminum ethyl sulfinate, $Al(SO_2-C_2H_5)_3$: Aluminum, 8.80 per cent; sulfur, 31.40 per cent; Carbon, 23.52 per cent; Hydrogen, 4.94 per cent.

The analysis agrees well with the values for aluminum ethyl sulfinate. The disulfone derivative (1,2 diethylsulfonylethane, $C_2H_5SO_2C_2H_4SO_2C_2H_5$) was prepared from the product. The melting point was 136 C.; the value given in the literature is 136-137°C. The diethyl sulfone derivative, $C_2H_5SO_2C_2H_5$, was made. The melting point was found to be 71-72°C.; the melting point given in the literature is 71°C.

Reaction of Aluminum Triethyl Etherate with Nitrogen Dioxide.

Pure, dry nitrogen dioxide was distilled into the reaction flask which contained a diethyl ether solution of aluminum triethyl etherate and was cooled with Dry Ice-acetone. After the desired quantity of nitrogen dioxide had been added, the reaction mixture was allowed to warm to room temperature and then to stand for several hours. After hydrolysis, the resulting paste or slurry was extracted with ether. The ether extracts were dried over barium oxide, the barium oxide was filtered off, and the ether was distilled off. The reaction product was vacuum distilled.

The reaction product boiled at 132-134°C., with some decomposition, was basic to litmus, and reduced ammoniacal silver nitrate. The refractive index was 1.416 at 26.5°C., and the determination of the neutral equivalent gave a value of 97. The reaction product was thought to be N,N-diethylhydroxylamine, $(C_2H_5)_2NOH$, whose boiling point is recorded as 130-134°C., and which is basic and has reducing properties similar to those of the reaction product. The oxalate derivative of the reaction product melted at 135-138°C.; literature value for the oxalate of N,N-diethylhydroxylamine is 137-139°C. The infrared spectra of a sample of N,N-diethylhydroxylamine and of the reaction product were run. The liquids were used without solvents. The two infrared spectra are essentially the same, but each sample apparently contained an impurity not present in the other. The reaction product was analyzed and gave the following results: Carbon, 53.72, 53.93 per cent; Hydrogen, 11.82, 11.89 per cent; Nitrogen, 14.70, 14.93 per cent. Calculated for N,N-diethylhydroxylamine: Carbon, 53.89 per cent; Hydrogen, 12.44 per cent; Nitrogen, 15.72 per cent.

Reaction of Aluminum Triethyl Etherate with Nitric Oxide.

Nitric oxide was bubbled into an ether solution of aluminum triethyl etherate for seven and one-half hours. The solution was then allowed to stand overnight in contact with nitric oxide. Any remaining nitric oxide was swept out with nitrogen and the reaction mixture was hydrolyzed, acidified with sulfuric acid, and extracted with ether, then with benzene. The ether and benzene extracts were treated with a slurry of hydrous copper oxide. The excess copper oxide was filtered off and the filtrates were evaporated. The residue of copper salt was dissolved in benzene, filtered, and evaporated under reduced pressure. Beautiful, long, dark-purple crystals were obtained. These were dissolved in water and, after the water had evaporated partly, the larger crystals were separated.

The product was thought to be ethylnitrosohydroxylamine, $C_2H_5N(NO)OH$. However, very little work has been done with nitrosohydroxylamines and particularly with ethylnitrosohydroxylamine. The lack of information on the properties of this compound and its salts made positive identification difficult. The copper salt was analyzed and gave the following results: Carbon, 20.09, 19.99 per cent; Hydrogen, 4.16, 4.21 per cent; Nitrogen, 23.18, 23.00 per cent. Calculated for ethylnitrosohydroxylamine (anhydrous): Carbon, 19.87 per cent; Hydrogen, 4.17 per cent; Nitrogen, 23.18 per cent.

Reaction of Aluminum Triethyl Etherate with Pyridine.

Dry pyridine was added in excess to aluminum triethyl etherate. The excess pyridine was evaporated under a vacuum until the product was losing weight at an approximately constant slow rate and until small amounts of aluminum were detected in the trap. The product was an amber-colored liquid which decomposed, becoming bright red and precipitating a solid, before boiling at ordinary pressures. The product was diluted with ether and hydrolyzed under reflux to minimize loss of pyridine. The acidified solution was diluted to a suitable volume and aluminum was determined on aliquot portions. Found: 14.24 per cent Al. Calculated for $Al(C_2H_5)_3 \cdot C_5H_5N$, 13.96 per cent Al. Pyridine was determined on different aliquot portions of the same sample by distilling it from a highly alkaline solution into a measured amount of standard hydrochloric acid. The excess hydrochloric acid was determined by titration with standard base by means of a pH meter. Found: 40.2 per cent pyridine. Calculated for $Al(C_2H_5)_3 \cdot C_5H_5N$, 40.93 per cent pyridine.

Additional Reactions of Aluminum Triethyl Etherate.

Carbon dioxide was bubbled through aluminum triethyl etherate for several days. In one run the reaction flask was surrounded by an oil bath kept at 100°C. There was very little evidence of reaction. The reaction mixture was hydrolyzed, syrupy phosphoric acid was added, and the solution was distilled. Duclaux constants and an approximate equivalent weight determination indicate that a mixture of acetic and propionic acids was formed. The odor of acetic acid was present when some of the salt mixture was acidified with sulfuric acid.

A white solid product is formed when aluminum triethyl etherate is reacted with dry air. A sample of this product was hydrolyzed and the solution filtered. The filtrate gave

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a positive iodoform test but analytical results do not indicate a theoretical yield of aluminum ethylate.

With sulfur trioxide and aluminum triethyl etherate, there is extensive charring which could not be eliminated.

Two experiments were carried out in which aluminum triethyl etherate and carbon tetrachloride were mixed. In the first, the carbon tetrachloride was added at room temperature; a vigorous reaction took place and considerable chloride was formed. In the second experiment, carbon tetrachloride was added to aluminum triethyl etherate at -20°C. to -30°C. The reaction mixture was allowed to warm to room temperature and to stand overnight, but little chloride was formed.

Conclusions

A phase study has been made of the binary system aluminum triethyl-diethyl ether. The presence of a 1:1 compound with a freezing point of about -65°C. is indicated. The freezing point of the etherate has been determined directly as -64.0°C., and the freezing points of mixtures made by ether additions to the etherate confirm the belief that the etherate is a 1:1 compound. The analysis of the etherate for aluminum also indicates that it is a 1:1 compound. These results contradict the literature where it has been claimed that the etherate is $4Al(C_2H_5)_3 \cdot 3(C_2H_5)_2O$.

The reactions of aluminum triethyl etherate with sodium ethyl and with lithium ethyl have been carried out to yield sodium aluminum tetraethyl and lithium aluminum tetraethyl, which have been isolated and analyzed.

With sulfur dioxide, aluminum triethyl etherate gives aluminum ethyl sulfinate in almost quantitative yield. The identity of the product was proved by analysis, by conversion to diethyl sulfone, and by formation of the disulfone derivative of ethyl sulfinic acid.

Aluminum triethyl etherate reacts with nitrogen dioxide to give a product, which when hydrolyzed yields N,N-diethylhydroxylamine. This compound was identified by its physical and chemical properties and by comparison of its infra red spectrum with the infrared spectrum of N,N-diethylhydroxylamine prepared by a known method.

With nitric oxide, aluminum triethyl etherate gives a product, which, when hydrolyzed, yields ethylnitrosohydroxylamine. This was identified by the analysis of its copper salt.

Pyridine reacts to form a 1:1 compound, which was isolated and analyzed.

Aluminum triethyl etherate reacts very slowly with carbon dioxide, giving small amounts of solid, which, when hydrolyzed, yield propionic and acetic acids. With oxygen from dry air, aluminum triethyl etherate forms a white solid, which was not purified nor identified. With sulfur trioxide extensive charring occurs. With carbon tetrachloride some chloride is formed.

It would appear from this study that in most reactions with simple inorganic compounds, aluminum triethyl etherate behaves in a manner similar to other metal alkyls. It differs from a Grignard reagent in its extremely slow reaction with carbon dioxide.

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Abstract published by special arrangement with The Ohio State University.

AN INVESTIGATION OF THE STRUCTURE OF DIAZO KETONES BY INFRARED SPECTRA

(L. C. Card No. Mic 58-879)

Henry Nelson Beck, Ph.D.
University of Michigan, 1957

The purpose of this investigation was to study the structure of diazo ketones by means of their infrared spectra. The preparation and physical properties of a series of benzil derivatives, eighteen aromatic and aliphatic diazo ketones, two simple diazo compounds, one diazo ester, and the necessary intermediates and derivatives are described. The infrared spectra of the compounds were carefully recorded from 4000 $cm.^{-1}$ to 600 $cm.^{-1}$ by the use of a calibrated Perkin-Elmer infrared spectrophotometer, Model 21, equipped with sodium chloride optics. The positions of the bands in the "triple-bond," the "carbonyl," and the "double-bond" regions of the spectrum were carefully measured.

A gradual bathochromic shift in the carbonyl stretching frequency from its position in the spectrum of benzil through the derivative spectra to that in the corresponding diazo ketone, 2-diazo-2-phenylacetophenone, has been observed. The frequency shift is explained by "conjugate-chelation," ordinarily exhibited by compounds of the general structure -C(XH)=C-C(=Y)-, and is shown also to include compounds of the type :N(XH)=C-C(=Y)-.

The values reported for the characteristic absorption frequencies in the "triple-bond" region due to an NN stretching vibration shown by the simple diazo compounds extends the range of reported absorption for this type of compound from 2103-2082 $cm.^{-1}$ to 2103-2052 $cm.^{-1}$ The exact position of the NN band in these compounds appears to be dependent upon the ring strain at the carbon atom to which the diazo group is attached and upon the amount of conjugation present.

The diazocarbonyl compounds show characteristic NN stretching frequencies between 2142 $cm.^{-1}$ and 2078 $cm.^{-1}$ and CO stretching frequencies between 1693 $cm.^{-1}$ and 1594 $cm.^{-1}$. The NN bond appears to be between a double and a triple bond in nature, and the CO bond, somewhat ionic or modified in the sense $C^{\oplus}\!\!-\!\!O^{\ominus}$.

The NN frequency in substituted diazoacetophenones is shown to be dependent upon the position and the electron-

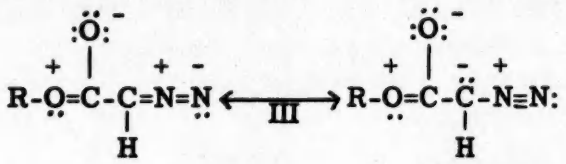
The items following each abstract are: the number of manuscript pages in the dissertation, its cost on microfilm, and the Library of Congress card number. Enlargements 5-1/2 x 8-1/2 inches, 4 cents per page. No postage is charged if check or money order accompanies order.

attracting or -repelling power of the substituent, the frequency increasing with meta substitution and increased electron-withdrawing ability of the substituent. Doubts arising from several instances of uncertain assignment prohibit similar correlations of the CO frequency. Both the NN and the CO frequency in aliphatic diazo ketones (I) are shown

$RCOCHN_2$ $C_6H_5\text{-}CO\text{-}C(N_2)\text{-}R'$

I II

to be dependent upon the electron-attracting or -repelling nature of R, both frequencies increasing as R becomes more electron-attracting. Changing the nature of R' (II) from hydrogen to methyl and phenyl has no effect upon the CO frequency, but considerably reduces the NN frequency. The data obtained from the diazo ester indicate that its structure is slightly different from the diazo ketones, and it is suggested that resonance structures of the kind shown in III may contribute appreciably to the ground state.



III

163 pages. $2.15.

THE REARRANGEMENT OF SUBSTITUTED ALLYL BENZIMIDO ETHERS

(L. C. Card No. Mic 58-1106)

Clifford Sturgis Benton, Ph.D.
University of Minnesota, 1957

The preparation and chemical properties of the class of compounds known as imido ethers or imidic esters has been reviewed, special attention being given to the behaviour of these compounds on pyrolysis. The various pyrolytic mechanisms have been discussed with particular emphasis being given to the pyrolytic rearrangement of N-phenylbenzimido alkyl ethers.

In a previous work, carried out by Lauer and Lockwood, it had been shown that N-phenylbenzimido γ,γ-dimethylallyl ether rearranged on pyrolysis to give ortho benzamido γ,γ-dimethylallyl benzene. This product was explained by postulating two normal Claisen type rearrangements, the N-substituted normal product being the unstable intermediate in the process.

It was the initial problem of the present research to determine whether a Claisen para rearrangement would result in a compound of the forementioned type if the ortho positions were blocked. In order to carry out this investigation, the preparation of N-2,6-dimethylphenyl benzimido γ,γ-dimethylallyl ether was accomplished, and this compound then heated to above 200°C. Instead of the rearrangement product expected, the imido ether was shown to have decomposed to yield only the corresponding amide, N-2,6-dimethylphenyl benzamide. The γ,γ-dimethylallyl group was evidently liberated from the molecule as isoprene and resinous isoprenoids.

A second problem was undertaken to determine whether the γ-ethylallyl group in the imido ether series migrated on pyrolysis to yield a mixture of normal and abnormal products as previously noted in the phenyl γ-ethylallyl ether series by Lauer and Filbert and later by Hurd and Pollack. These investigators showed the pyrolysis product to be a mixture of ortho ethylvinylcarbinyl phenol and ortho methyl-n-prop-1-enylcarbinyl phenol.

In order to carry out this second problem, N-phenylbenzimido γ-ethylallyl ether (I) was prepared and pyrolyzed. A viscous, liquid amide was obtained at 235°C. On heating this liquid amide to 290°C. (or heating a portion of the original imido ether to 290°C.) a solid amide was obtained.

The viscous, liquid amide was shown to consist solely of the normal rearrangement product, N-ethylvinylcarbinyl benzanilide (II). This is the product expected from normal attachment of the carbon atom of the γ-ethylallyl group to the nitrogen atom. The following data were presented to substantiate the structure of the liquid amide, obtained at 235°C, as being that of N-ethylvinylcarbinyl benzanilide (II):

1. Ozonolysis of the liquid amide yielded a carboxylic acid identified as N-benzoyl-N-phenyl-α-amino-n-butyric acid.

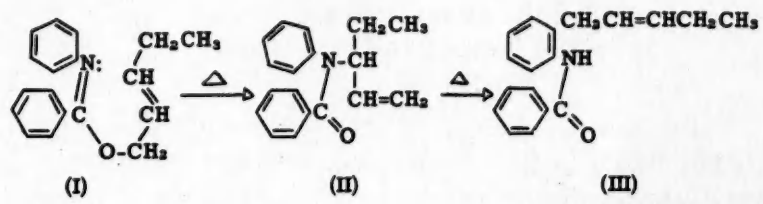
2. Further heating of the liquid amide to 290°C. yielded N-2-γ-ethylallylphenyl benzamide, the expected product of a normal allylic rearrangement from N-ethylvinylcarbinyl benzanilide.

The solid amide obtained by pyrolysis of N-phenylbenzimido γ-ethylallyl ether at 290°C was shown to be N-2-γ-ethylallylphenyl benzamide (ortho benzamido γ-ethylallylbenzene) by the following ozonolysis data:

1. Hydrolysis of the ozonide yielded a volatile aldehyde identified as propionaldehyde.

2. Oxidation of the residual non-steam volatile aldehyde from ozonide hydrolysis yielded a solid acid identified as N-benzoyl ortho anthranilic acid.

The rearrangement is thus represented by the following reaction sequence:-



(I) (II) (III)

86 pages. $2.00.

THE REACTION OF OXYGEN WITH VINYL MONOMERS IN THE PRESENCE OF FREE RADICALS

(Publication No. 24,948)

Stewart C. Brown, Ph.D.
University of Delaware, 1957

Supervisor: Dr. Elizabeth Dyer

The reaction of oxygen with acrylonitrile in bromobenzene solution using bis(o-chlorobenzoyl) peroxide as initiator has been investigated. The rate expression obtained was:

$$-\frac{dO_2}{dt} = k\,[ACN]^{1.6}\,[Peroxide]^{0.6}$$

The kinetics of the reaction of oxygen with methacrylonitrile in the presence of 2,2′-azobisisobutyronitrile have also been investigated. The rate expression obtained was:

$$-\frac{dO_2}{dt} = k\,[MACN]^{1.0}\,[ADBN]^{0.5}$$

The rates of oxygen absorption for several other vinyl monomers have been determined and correlated with their structures.

A series of new polymeric α-alkyl acrylonitrile peroxides has been prepared from α-ethyl, α-isopropyl, and α-n-amyl acrylonitrile. The Nozaki method of peroxide analysis was unreliable for these compounds, but the method of Mayo and Miller gave values that were in agreement with the elementary analyses and which showed that these compounds are nearly perfect 1:1 copolymers of oxygen and monomer. These peroxides all have a relatively low degree of polymerization. The various peroxides all have approximately the same degree of thermal stability, regardless of the nature of the α-alkyl substituent. It has also been established that the formaldehyde resulting from the attack of oxygen on these α-acrylonitriles is a primary oxidation product. 79 pages. $2.00. Mic 58-4791

I. EFFECT OF VARIOUS CATIONS ON THE WILLIAMSON REACTION. II. SOME STERIC HINDRANCE CONSIDERATIONS OF THE REFORMATSKY REACTION.

(Publication No. 25,439)

Franklin James Evans, Jr., Ph.D.
The Ohio State University, 1952

Part I

For many years the emphasis in the study of organic reactions involving inorganic ionic reagents has been placed on the anion and little attention has been paid to the cation. However, much information has accumulated on the effect of cations in both homogeneous and heterogeneous reactions. Many of the differences observed can be explained on the basis of the inherent tendency of the respective cations to coordinate or form covalent linkages with the organic anions. This tendency decreases from lithium to cesium and is practically non-existant for the tetraalkylammonium ion.[1]

The present investigation was undertaken to determine if such a change of cations would have any effect on the Williamson reaction. This particular reaction was chosen for the study since it is a typical S_N2 displacement reaction. The Williamson reaction is normally used for the synthesis of ethers by interaction of an alkyl halide and sodium alkoxide. However, it is generally accompanied by a side reaction producing some of the corresponding olefin. The formation of ether and olefin in this reaction are both irreversible reactions and the ratio of the two products measures the ratio of the two rates.

(1) $R'-CH_2-\overset{\delta+}{C}H_2-Br \longrightarrow M-O-R$ (OR attached to the β-carbon)

(2) $R'-\overset{\delta+}{C}H-CH_2-Br \longrightarrow M-O-R$ (OR attached to the α-carbon)

A series of reactions was conducted in which 2-ethylhexyl bromide was added to a solution of lithium, sodium, or potassium ethoxide under identical conditions. The amount of 2-ethylhexene-1 and ethyl-2-ethylhexyl ether formed was determined. The ratio of olefin to ether produced was 2.29 for lithium, 2.10 for sodium, and 2.02 for potassium. It may be of some theoretical interest to see if the observed trend would continue through the elements of rubidium and cesium, but the cost and availability of these metals for practical synthetic work is prohibitive. The slight difference in ratio found was of no practical importance from a synthetic view point and the problem was abandoned.

Part II

A tremendous amount of information has been reported on the Reformatsky reaction, both on its study per se and on its utilization in synthetic work.[2,3,4,5] Most studies of the reaction have dealt with the "normal" Reformatsky product and relatively little work has been done on the study of the by-products. In most instances the most important side reaction products stemming from bromoester have been found to be the reduced ester and β-ketoester, although other side products have also been found. All explanations for the formation of β-ketoester postulate a condensation of the organozinc halide with the carbonyl group of a second molecule.

(A) $R'-CHBr-COOR + Zn \longrightarrow [R'-CH-COOR]ZnBr$ (I)

(B) (I) + proton donor $\longrightarrow R'-CH_2-COOR$ (II)

(C) (I) + $R'-CHBr-COOR \longrightarrow R'-CHBr-C(OR)(OZnBr)-CH(R')-COOR$ (III)

(III) $\xrightarrow{-ROZnBr}$ $R'-CHBr-CO-CH(R')-COOR$ (IV)

An analogous carbonyl addition reaction is the acid-catalyzed esterification of carboxylic acids. In the latter case, the effect of structure of the acid on the rate of the reaction has been investigated[6,7] and an explanation in the light of steric factors proposed.[8] The present investigation was undertaken in an attempt to determine if the introduction of suitable steric factors would inhibit the self condensation reaction and promote increased yields of the "normal" Reformatsky product.

The methyl, ethyl, n-propyl, i-propyl, i-butyl, t-butyl, and neopentyl esters of -bromopropionic acid were prepared and reacted with zinc in a benzene-ether solution. The amount of zinc reacted and the amount of reduced

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TABLE I

Exp.	Ester	% Zn Reacted	% Reduced Ester	% -Keto-ester	% Recovered -Bromoester	Residue - g.
12	Me	71.0	25.6	16.4	5.6	17.5
13	Me	73.0	25.8	15.3	5.2	18.1
14	Et	89.0	19.2	37.7	0.0	13.8
15	Et	89.6	19.7	38.7	0.0	14.8
16	Et	89.2	19.5	37.2	0.0	14.0
17	n-Pr	82.8	16.2	39.4	0.0	14.6
18	n-Pr	84.6	16.8	39.8	0.0	15.2
19	i-Pr	3.6	2.8	0.0	92.2	1.5
20	i-Pr	4.0	3.0	0.0	92.7	0.5
21	i-Bu	29.0	11.8	0.0	60.9	10.9
22	i-Bu	27.7	10.0	00.0	64.5	10.2
23	t-Bu	1.6	—	—	86.7	—
24	neopentyl	3.6	2.8	0.0	90.6	3.2
25	neopentyl	3.0	2.5	0.0	93.8	0.5
26	Ethyl bromo acetate	91.6	44.5	9.8	0.0	12.2

ester and β-ketoester formed were determined. The results of this comparison are summarized in Table I.

The amount of zinc reacted (based on a 1:1 ratio with the bromoester used) was as follows: methyl, 72; ethyl, 89; n-propyl, 84; i-propyl, 3.8; i-butyl, 28; t-butyl, 1.6; and neopentyl, 3.3 per cent. It thus appeared that as the steric factors were increased in an attempt to inhibit the self condensation reaction they also inhibited the reaction of the bromoester with zinc.

The same series of esters was then reacted with zinc in the presence of benzophenone. The results of this comparison are summarized in Table II.

TABLE II

Exp.	Ester	% Zn Reacted	% Reformatsky Product	% Reduced Ester	% Recovered Bromoester
23	t-Bu	1.6	—	—	86.7
27	Et	98.8	86.8[1]	3.7	—
28	i-Pr	3.0	—	—	86.7
29	i-Bu	99.4	87.2[2]	1.0	—
30	neopentyl	3.4	—	—	87.8
31*	Et	97.8	72.7[3]	3.2	—

*Ketone- 5,8-dimethyl-1-tetralone; all other ketones were benzophenone

[1] m.p. 101-102°

[2] m.p. 85-87°

[3] b.p. 170-174° at 8 mm., n^{28} 1.5392

In this case the following amounts of zinc reacted: ethyl, 98.8; i-propyl, 3.0; i-butyl, 99.4; t-butyl, 1.6; and neopentyl, 3.4 per cent. The esters which had shown very little activity in the absence of a ketone continued to display little activity in the presence of a ketone. It is of special interest to note that the i-butyl ester, which had consumed only about 29 per cent of the zinc in the absence of a ketone, now, in the presence of a ketone, consumed 99.4 per cent of the zinc and gave an 87.2 per cent yield of Reformatsky product. It thus appeared that the use of the i-butyl ester may considerably improve the yield of Reformatsky reactions in which the yield of "normal" product is low because of formation of β-ketoester in large amounts by the self condensation of the starting bromoester.

An increased extent of reaction was noted early in the work by using a benzene-ether solvent rather than benzene alone. The reaction of ethyl α-bromopropionate and 5,8-dimethyl-1-tetralone in benzene alone has been reported to yield 17 per cent of Reformatsky product.[9] When this same reaction was carried out following a procedure developed by Bachmann[10] (a 300 per cent excess of bromoester and a 500-600 per cent excess of zinc added in portions to a refluxing benzene-ether solution of the ketone), a yield of 82 per cent was obtained.[9] The improved yield obtained by this procedure has been interpreted as owing to the large excess of zinc and bromoester present. It was believed that these reagents were supplied in sufficient amounts to compensate for the losses of bromoester and zinc in the side reactions. This same reaction was attempted in a benzene-ether solvent using equivalent quantities of ketone and bromoester. A yield of 73 per cent of Reformatsky product was obtained. It therefore appeared that the major factor in the differences in yield was the solvent effect, not the excess of reagents. Further investigation of solvent effects on this type of reaction appear to be indicated. 75 pages. $2.00. Mic 58-4792

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Abstract published by special arrangement with The Ohio State University.

STUDIES ON CYCLOHEPTATRIENE DERIVATIVES

(L. C. Card No. Mic 58-1081)

Filon A. Gadecki, Ph.D.
University of Washington, 1957

The cycloheptatrienylium ion was studied by a variety of physical methods to determine the extent of aromatic character possessed by the species. Spectral analysis by various workers demonstrated that the ion was a symmetrical planar entity possessing vibrational and electronic spectra concomitant with an aromatic system. The extent

of ionization of tropenium bromide was determined by conductivity measurements in aqueous solution. The results obtained indicated that the compound was appreciably ionized, but was undergoing subsequent partial hydrolysis ($K_{hydrolysis} = 4.2 \times 10^{-5}$). The relative degree of dissociation of tropenium bromide was compared to the corresponding triphenylmethyl salt in acetonitrile. It was demonstrated that the former was far more ionized ($K \sim 10^{-2}$ to 10^{-3}) than the latter ($K \sim 10^{-6}$). Using the extent of ionization as an indication of resonance stabilization, it was concluded that the cycloheptatrienylium ion had more resonance energy than the triphenylmethyl carbonium ion relative to their respective hydrocarbon analogs.

The ease of reduction of the tropenium ion was measured by polarography. The data indicated that the ion was easily reduced (at -0.60 to -0.67 volts vs. S. C. E. at pH 4) by what appeared to be an one electron process (pH independent). Similar results were obtained with tropone (at -0.72 volts vs. S. C. E. at pH 4) but the reduction was shown to be pH dependent (as was also reported for tropolone). All these species had in common (tropone and tropolone after acquiring a proton) the cycloheptatrienylium nucleus. The results thereby demonstrated that initial reduction (presumably generating the free radical) was easy to effect but subsequent to this the system was quite stable and resisted further reduction. The transition from carbonium ion to free radical apparently involved a relatively low energy barrier and the resultant radical had appreciable resonance stabilization, in consonance with theoretical prediction.

Other physical measurements such as X-ray crystallography and mass spectrometer data were reported but were not as definitive in their interpretation. All the physical data assimilated verifies the presence of a stable, nonclassical aromatic species in the tropenium ion and substantiates the mathematical procedure and predictions of E. Huckel with regard to its properties.

The polarographic reduction measurements in conjunction with the proposed mechanism of decomposition of cycloheptatrienylium iodide indicate the apparent stability of the tropenyl radical. Experiments designed to generate the corresponding anion as a product or reaction intermediate were unsuccessful. The results obtained therefore provide evidence that aromatic stabilization in 7-membered conjugated rings was in the order, carbonium ion > radical > carbanion, as predicted by theory.

The versatility and adaptability of the hydride exchange reaction was investigated and resulted in the preparation of new tropenium salts. Indications toward a more general application of the process were considered and requirements for successful exchange were suggested. The utilization of the method was contemplated as a route to the preparation of the theoretically important bi-fulvene, cycloheptatrienylidenecyclopentadiene (sesquifulvalene) and cycloheptatrienylidenecycloheptatriene (heptafulvalene). The results indicated, however, that the bi-fulvenes were not readily obtained by this preparative scheme.

193 pages. $2.55.

PREPARATION OF COMPOUNDS OF POTENTIAL PHYSIOLOGICAL ACTIVITY: AMINO AND THIO ESTERS OF SUBSTITUTED BENZILIC AND GLYCOLIC ACIDS AND RELATED COMPOUNDS

(L. C. Card No. Mic 58-1321)

Dan Millard Glenn, Ph.D.
University of Tennessee, 1957

Major Professors: Hilton A. Smith and C. A. Buehler

Several substituted benzilic and glycolic acids were prepared and various amino and thio esters of these acids were synthesized. The new compounds which were prepared as intermediates or as by-products in the preparation of the new acids are listed below:

1. 3- or 4-Benzylcyclohexylbenzyl carbinol
2. Ethyl 3-phenylbenzilate
3. 3-Phenylbenzilic acid
4. 3-Phenylbenzaldehyde
5. 3,3'-Diphenylbenzoin
6. 3,3'-Diphenylbenzil
7. 3,3'-Diphenylbenzilic acid

Nineteen new compounds were prepared as possible antispasmodics and these compounds are listed below:

1. 2-Diethylaminoethyl 4,4'-diphenylbenzilate hydrochloride
2. 2-Diethylaminoethyl 3,3'-diphenylbenzilate hydrochloride
3. 2-Diethylaminoethyl 3-phenylbenzilate hydrochloride
4. One-third hydrogenated 2-diethylaminoethyl 3-phenylbenzilate hydrochloride
5. One-third hydrogenated 2-diethylaminoethyl 4-phenylbenzilate hydrochloride
6. 2-Diethylaminoethyl 3-cyclohexyldicyclohexylglycolate hydrochloride
7. 2-N-Piperidinoethyl 4,4'-diphenylbenzilate hydrochloride
8. 2-N-Piperidinoethyl 4-phenylbenzilate hydrochloride
9. 2-N-Piperidinoethyl 3,3'-diphenylbenzilate hydrochloride
10. 2-N-Piperidinoethyl 2,2'-dimethylbenzilate hydrochloride
11. 2-N-Piperidinoethyl 3,3'-dimethylbenzilate hydrochloride
12. N-Ethyl-3-piperidino 4,4'-diphenylbenzilate hydrochloride
13. N-Ethyl-3-piperidino 4-phenylbenzilate hydrochloride
14. N-Ethyl-3-piperidino 2,2'-dimethylbenzilate hydrochloride
15. N-Ethyl-3-piperidino 3,3'-dimethylbenzilate hydrochloride
16. 2-Methylthioethyl 2,2'-dimethoxybenzilate methiodide
17. 2-Methylthioethyl 2,2'-dimethylbenzilate methiodide
18. 2-Methylthioethyl 4,4'-dimethylbenzilate methiodide
19. 1,1-Diphenyl-1,2-dihydroxy-4-dimethylaminobutane hydrochloride

These compounds have been or will be submitted for physiological tests in the Pharmacology Branch of the Chemical Corps Laboratories in the Army Chemical Center.

141 pages. $2.00.

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A KINETIC STUDY OF THE HYDROGEN PEROXIDE OXIDATION OF SULFINIC ACIDS AND THIOLS

(Publication No. 24,951)

Reginald N. González, Ph.D.
University of Delaware, 1957

Supervisor: Dr. Harold Kwart

The hydrogen peroxide oxidation of several aromatic sulfinic acids and two aromatic thiols was studied kinetically in order to establish the mechanisms of these reactions. The oxidation of the sulfinic acids was shown to be pseudo second order, the pseudo second order rate constant being unaffected by pH, buffers, or neutral salts over a wide pH range, 2-9. The rate constant was influenced by the initial concentration of hydrogen peroxide.

The oxidation of p-methylthiophenol was found to be pseudo second order with the pseudo second order rate constant depending on buffer type and concentration, and initial hydrogen peroxide concentration. Oxidation of p-chlorothiophenol followed pseudo first order kinetics and was influenced by buffer and initial hydrogen peroxide concentration.

From the kinetic results, mechanisms have been proposed for the oxidation of sulfinic acids and thiols by hydrogen peroxide. In each case the oxidation involves a series of equilibrium and concerted reaction steps. Whilst the anionic form of the sulfinic acid or thiol was found to be the preferred, if not the essential reactive species, there was no evidence that hydrogen peroxide was cleaved either homolytically or heterolytically prior to reaction with the substrate. 126 pages. $2.00. Mic 58-4793

THE STEREOCHEMISTRY OF THE RANEY NICKEL DESULFURIZATION REACTION

(Publication No. 24,284)

Edwin Allen Grant Jr. Ph. D.
The University of Wisconsin, 1957

Supervisor: Associate Professor Eugene Earl van Tamelen

The preparation, determination of stereochemistry, and desulfurization of 1,2-disubstituted and 1,3-disubstituted mercapto and sulfonylcyclohexanes are described; the products of desulfurization are compared, through the use of infrared spectra, to alkylcyclohexanols of known stereochemistry in order to determine the steric course of Raney nickel desulfurizations. In addition, camphane derivatives having sulfur on the bridgehead carbon were prepared and exposed to desulfurization conditions to determine whether carbonium ion-like intermediates are involved when thioethers are desulfurized, and whether Raney nickel desulfurization of sulfones can proceed when inversion of configuration is impossible.

A. Trans-1,2-dimethyl-2-benzylmercaptocyclohexanol and the corresponding sulfone were prepared and desulfurized. Comparison of the infrared spectra suggested that both products of desulfurization were similar in composition. Comparison of these spectra with that of authentic trans-1,2-dimethylcyclohexanol suggested that both cis and trans isomers were present, in addition to olefinic products. The complexity of the product mixtures prevented accurate determination of their composition.

B. Cis- and trans-3-benzylmercapto-3-methylcyclohexyl β-naphthoates and the corresponding sulfones were prepared, separated and the stereochemistry of each proved. Desulfurization with Raney nickel of each in absolute ethanol gave a mixture of esters, which, when saponified, gave a homogeneous mixture of isomeric 3-methylcyclohexanols. The stereochemistry of either authentic cis- or trans-3-methylcyclohexyl β-naphthoate was not affected by either the desulfurization or saponification conditions used. The cis-thioether-ester and the cis-sulfone-ester gave, respectively, 37% and 43% inversion of configuration; the trans-thioether-ester and the trans-sulfone-ester gave, respectively, 44% and 54% inversion of configuration. These data were obtained from quantitative infrared analysis through the use of infrared spectra of mixtures of authentic cis- and trans-3-methylcyclohexanols of known composition. A common reaction intermediate of the free radical type is tentatively proposed pending further research on more complex models.

C. 4-Phenylmercaptocamphane and 4-benzenesulfonylcamphane were prepared from an intermediate of known structure, 4-camphyl lithium. Raney nickel desulfurization of each proceeded smoothly in absolute ethanol to yield camphane, which was compared with authentic camphane. These results indicate that the Raney nickel desulfurization reaction does not proceed through a carbonium ion-like intermediate (although an S_Ni mechanism may be possible) and that sulfone desulfurization need not proceed exclusively with inversion of configuration. In addition, these results are compatible with the free radical mechanism tentatively proposed for the Raney nickel desulfurization of cis- and trans-3-benzylmercaptocyclohexyl β-naphthoates and the corresponding sulfones.

98 pages. $2.00. Mic 58-4794

THE KINETICS OF REACTION OF ISOPROPYL METHYLPHOSPHONOFLUORIDATE (SARIN) AND DIISOPROPYL PHOSPHOROFLUORIDATE (DFP) WITH OXIMES

(Publication No. 24,953)

Brennie E. Hackley, Jr., Ph.D.
University of Delaware, 1957

Supervisor: Dr. William A. Mosher

The reaction between isonitrosoacetophenone and isopropyl methylphosphonofluoridate (Sarin) in near neutral aqueous solution has been examined kinetically. A reaction sequence has been postulated, involving a Beckmann rearrangement of the "second order," and has been supported on a stoichiometric basis. The phosphonylation of the α-keto oximate ion has been demonstrated to be rate determining and the overall reaction was second order i.e. first order with respect to each of the reactants.

In addition, the rates of reaction of over 50 oximes and

isonitroso compounds with Sarin and diisopropyl phosphorofluoridate (DFP) have been determined manometrically or titrimetrically. A linear free energy relationship between log K (anion) and pKa has been established for a series of oximes.

The inhibitory effect of bicarbonate-carbon dioxide buffer on the velocity of reaction of Sarin with oximes and hydroxamic acids has been examined.

88 pages. $2.00. Mic 58-4795

THE CHEMISTRY OF DERIVATIVES OF 2-BENZAL-1-TETRALONE

(L. C. Card No. Mic 58-627)

Alfred Hassner, Ph.D.
The University of Nebraska, 1956

Adviser: Norman H. Cromwell

In five- and six-membered alicyclic ketones with aliphatic side chains, the introduction of an olefinic bond can lead to exo- or endocyclic unsaturation. The purpose of this investigation was to synthesize and study the chemical behavior of certain exocyclic unsaturated six-membered ring ketones which are cyclic analogs of chalcones.

Trans-2-benzal-1-tetralone (IIa) and trans-2-benzal-4,4-dimethyl-1-tetralone (IIb) were prepared in good yields and their structures established from their chemical properties and absorption spectra. Both (IIa) and (IIb) showed great stability with acids and bases. They were catalytically hydrogenated to corresponding 2-benzyl-1-tetralones. The addition of bromine to (IIa) and (IIb) yielded the erythro-dibromoketones (IIIa) and (IIIb), while the reaction with alkaline hydrogen peroxide gave stable spiroepoxyketones in very good yields. One of the spiroepoxyketones, 2-benzal-4,4-dimethyl-1-tetralone oxide, was also synthesized by a Darzen's condensation to verify its structure.

The synthesis of 2-benzyl-4,4-dimethyl-1-keto-1,4-dihydronaphthalene (XI), the endocyclic isomer of (IIb), was accomplished in good yields by dehydrobromination of 2-bromo-2-benzyl-4,4-dimethyl-1-tetralone (VIb) with amines. The structure of (XI) was evident from its chemical properties and spectra studies, as well as from its arrangement to 2-benzyl-3,4-dimethyl-1-naphthol. The endocyclic unsaturated ketone (XI) did not react with amines, while the exocyclic 2-benzal-4,4-dimethyl-1-tetralone (IIb) added morpholine in a reversible manner. A procedure for the condensation of o-nitrobenzaldehyde with 1-tetralone and 1-indanone using 80% sulfuric acid was worked out.

Conformational analysis in 1-tetralones and the reaction of α-bromo six-membered ring ketones with amines was discussed. A study of the reaction of 2-bromo-2-benzyl-1-tetralones with amines was made. A novel rearrangement leading to 2-(α-aminobenzyl)-1-naphthols (IX) was observed in the reaction of 2-bromo-2-(α-bromobenzyl)-1-tetralone (IIIa) with cyclohexylamine, N-methylcyclohexylamine, piperidine and morpholine respectively. The naphthols (IX) were characterized by an independent synthesis via a Mannich type condensation. The Mannich reaction was also extended to include the condensation of 1-naphthol with o-nitrobenzaldehyde and morpholine. The interaction of 2-bromo-2-(α-bromobenzyl)-4,4-dimethyl-1-tetralone (IIIb) with piperidine or morpholine resulted in the isolation of the respective 2-(α-aminobenzyl)-4,4-dimethyl-1-keto-1,4-dihydronaphthalenes. The latter aminoketones could also be prepared from 2-(α-bromobenzyl)-1-keto-4,4-dimethyl-1,4-dihydronaphthalene and amines. 2-Bromo-2-benzyl-1-tetralone (VIa) was dehydrobrominated by amines in the cold to yield 2-benzyl-1-naphthol. Sterically hindered tertiary amines did not effect the dehydrobromination of either (IIIa), (IIIb), (VIa), or (VIb). A mechanism for the "abnormal" elimination of hydrogen bromide, consistent with the results observed in the reaction of 2-bromo-1-tetralones with amines, was proposed.

The ultraviolet and infrared absorption spectra of all pertinent cyclic ketones and 1-naphthol derivatives were determined and discussed. Analogies between the cyclic 2-benzal-1-tetralones and the open chain chalcones were pointed out. The introduction of a double bond into the ring of 4,4-dimethyl-1-tetralones causes an increased resonance interaction in the ground state of resulting 1-keto-1,4-dihydronaphthalenes, as indicated by the respective carbonyl frequencies, but no significant displacement of the high intensity band was observed in the ultraviolet spectra of these compounds. 145 pages. $2.00.

A STUDY OF THE REACTION BETWEEN PHENOLS AND ACYL PEROXIDES

(L. C. Card No. Mic 58-1340)

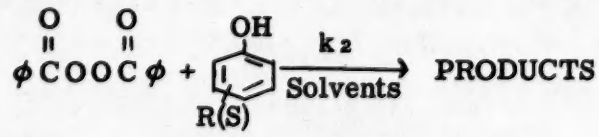
Russel B. Hodgdon, Jr., Ph.D.
Columbia University, 1957

Although several publications have appeared in the chemical literature concerning both acyl peroxide decomposition in phenolic and non-phenolic solvents, there has not appeared a complete study of the rapid reaction between various acyl peroxides and phenols. This dissertation concerns itself with an exhaustive study of this reaction with a special emphasis upon the evaluation of its mechanism.

Kinetics of the acyl peroxide-phenol reaction are thoroughly evaluated under a variety of experimental conditions. Conditions varied are natures and concentrations of both acyl peroxide and phenols, solvent media, and temperature. With the lone exception of higher temperatures (>45°C.) the acyl peroxide-phenol reaction is shown to be first order in peroxide, first order in phenol, and second order over all.

$$\text{RATE} = k_2 \,(\text{RCOOOOCR})\,(\text{PHENOL})$$

Mechanism of the acyl peroxide-phenol reaction is proposed on the basis of the evaluation of several experimental results and features of the over all reaction.



1. By deuterating the above phenolic hydroxyl group, a small but apparent isotope effect is found.

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2. By variation of the nature of the R groups in the above equation, variations in k_2 and in products are found.
3. The addition of radical traps such as iodine or diethyl maleate had no effect on the above reaction.
4. Determination of the kinetic order of the acyl peroxide-phenol reaction show the absence of the reaction.
5. Carbon dioxide determinations show (by an absence of detectable CO_2) that ØCOO. is never formed in any appreciable amounts when acyl peroxides react with phenols.

$$\text{ØC(=O)OOC(=O)Ø} \longrightarrow 2\ \text{Ø C(=O)O}\cdot$$

6. If the 2 and 6 positions of the phenol are substituted with alkyl or methoxy groups, the reaction with an acyl peroxide is not only sterically hindered, but varies in respect to nature of product as well.
7. Variance of solvent media varies the rate of identical acyl peroxide-phenol reactions.
8. Acid or basic solvents do not increase the rate of reaction between an acyl peroxide with a phenol.
9. Meta phenolic substituents have much smaller polar effects than the same para phenolic substituents.
10. Thermodynamic quantities (most notably ΔS^*) suggest the initial formation of a complex.

The above findings suggest a bimolecular rate determining step leading to the formation of a complex centered about the hydroxyl group of the phenol involving one undissociated molecule of acyl peroxide.

Because of findings 3,4,5, and 7 above, it is certain that this reaction is not of the free radical type.

Because of 8 above, it is certain this reaction is not of the carbonium or carbanion type.

Two proposed mechanisms based on the above experimental findings are presented.

Experiments on product analysis of the acyl peroxide-phenol reaction lead to the discovery of new products. These are discussed. 65 pages. $2.00.

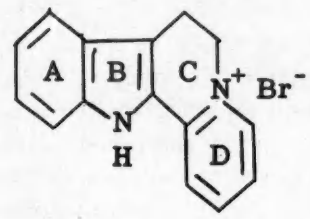
AN INVESTIGATION OF SYNTHESES OF TETRACYCLIC β-CARBOLINES

(L. C. Card No. Mic 58-1422)

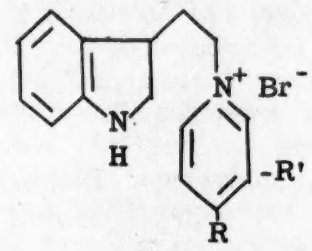
Jeanne Wecker Mund Lagowski, Ph.D.
University of Michigan, 1957

Synthetic routes to tetracyclic β-carbolines, related to the indole alkaloids, of the type illustrated by structure I, 6,7-dihydro-12H-indolo[2,3-a]quinolizinium bromide, were investigated with the view of introducing substituents into Rings A and D.

A new synthesis of I was accomplished by establishing Rings A, C, and D and then closing Ring B. Starting with either pyridine-2-carboxaldehyde or pyridine-2-carboxylic acid, and proceeding via the phenylhydrazone of 1-keto-1, 2,3,4-tetrahydroquinolizinium bromide (II), a Fischer closure of the indole ring gave I. Functionality was incorporated in Ring A by reacting substituted phenylhydrazines with II; however, difficulties encountered in preparing the required disubstituted pyridines precluded adaptation of this method to the introduction of substituents in Ring D.



I



III

Aromatization of Ring C of the reduction product of I, 1,2,3,4,6,7,12,12b-octahydro[2,3-a]quinolizine, was attempted because the C-1 hydrogens of the resulting 1,2,3,4-tetrahydroindolo[2,3-a]quinolizinium cation would be reactive providing a means to incorporate substituents in Ring D after synthesizing the tetracyclic system. Iodine-potassium acetate failed to effect aromatization; palladium-maleic acid dehydrogenation appeared promising, although no product was isolated.

The action of lithium aluminum hydride and sodium borohydride on 1-(β - [3-indoly] ethyl)pyridinium bromide (III, R=R'=H) was investigated as a potential method to prepare the tetracyclic β-carboline nucleus. The pyridine moiety was partially reduced, but cyclization was not effected. Since reductive cyclization has been reported on treatment of 2-(β- [3-indolyl] ethyl)isoquinolinium bromide (IV) with lithium aluminum hydride by Potts and Robinson, electronic effects associated with the double bonds of the benzene ring of isoquinoline must play a role in the ring closure. In view of this, the action of the two metal hydrides on pyridinium compounds carrying substituents (III, R' =H, R=-CH=CHC$_6$H$_5$ or -CO$_2$CH$_3$, and R=H, R'= -CO$_2$CH$_3$) which might be expected to exert a stabilizing effect on the Δ^3 double bond were studied. Reduction, not reductive cyclization, was observed in all cases investigated. Further, it was shown that only reduction accompanied treatment of IV with sodium borohydride. The limitations of this reaction, as well as its mechanism, warrant further study. 129 pages. $2.00.

AN INVESTIGATION OF THE REDUCTION OF CARBON-CARBON UNSATURATION BY ALKALI METALS IN LIQUID AMMONIA

(L. C. Card No. Mic 58-1323)

Donald Richard Larkin, Ph.D.
University of Tennessee, 1957

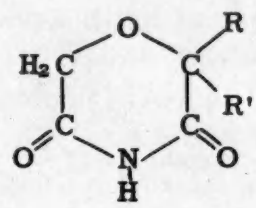
Major Professor: Jerome F. Eastham

Two lines of evidence were adduced to support the electron addition or "ionic" mechanism for the reduction of carbon-carbon unsaturation by alkali metal and alcohol in liquid ammonia. First it was shown that the reduction itself is extremely fast, much faster than the reaction between alkali metal and alcohol in liquid ammonia to produce hydrogen. The rate of reaction of the metal with the

alcohol was decreased immensely (by adding alkoxide ion or changing alcohols) without effecting the rate at which carbon-carbon unsaturation is reduced. Second, competitive reactions showed that an organic substrate with a net negative charge was reduced more slowly than were neutral substrates. These facts were taken as evidence that the rate-controlling process in the reduction is the reversible pick up of electrons from the solvent by the organic substrate to form carbanions; these then add protons irreversibly.

As a correlary of the above work, the properties of the dihydronaphthalenes were extensively investigated. 5,8-Dihydro-1-naphthol and its methyl ether were shown to be isomerized by alkali predominately to the 5,6-dihydroisomers, although the production of some 7,8-dihydroisomer in the isomerization was demonstrated. The structure of the 5,6-isomer was proven by degradation and that of the 7,8-isomer by both degradation and synthesis. A logical method of predicting the direction of isomerization of substituted-5,8-dihydronaphthalenes was presented and the ultraviolet spectra of ortho and meta substituted styrenes were discussed and compared.

Also as a correlary of this work, a number of organic compounds were synthesized. An unequivocal synthesis of 1-amino-7,8-dihydronaphthalene was accomplished but the overall yield was small. No simple method of producing 1-substituted-dihydronaphthalenes in good yield was found although several synthetic schemes were tested. A good, general synthesis for 2-substituted-dihydronaphthalenes from a commercially available compound, 1-tetralone, was devised and exploited. 187 pages. $2.45.



VIII, R = C_6H_5, R' = C_2H_5

Type C

Substituted 3,5-thiamorpholinediones (Type A) were obtained by the following series of reactions. Alkaline hydrolysis of 5,5-disubstituted-2-imino-4-thiazolidones led to the formation of disubstituted mercaptoacetic acids and amides. The action of the appropriate α-halo amide gave a mixture of the corresponding substituted thiodiacetamide and α-carbamylmethylmercaptoacetic acid. Ring closure with concentrated hydrochloric acid or high temperatures gave the imides (I-V).

2,2-Disubstituted-3,5-thiamorpholinedione-1, 1-dioxides (Type B) were prepared by oxidation of the corresponding type A compounds with hydrogen peroxide in acetic acid. The sulfones (VI-VII) were thus obtained.

2-Ethyl-2-phenyl-3,5-morpholinedione (Type C) was made as follows. The sodio salt of methyl ethylphenylhydroxyacetate was reacted with ethyl bromoacetate in dry benzene. Ammonolysis of the diester thus obtained gave α-ethyl-α-phenyldiglycolamide. Pyrolysis of this diamide gave the imide (VIII).

Compounds I-VIII have been submitted for pharmacological evaluation as possible hypnotics and anticonvulsants. 101 pages. $2.00. Mic 58-4796

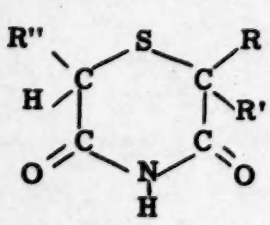
DERIVATIVES OF 3,5-THIAMORPHOLINEDIONES AND 3,5-MORPHOLINEDIONES

(Publication No. 24,959)

John R. Lovett, Ph.D.
University of Delaware, 1957

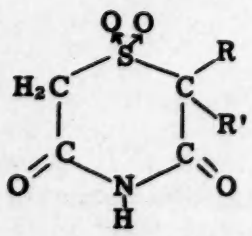
Supervisor: Dr. Glenn S. Skinner

The synthesis of representative compounds of the following three types, A, B and C has been accomplished:



I, R = $C_6H_5CH_2$, R' = C_2H_5, R'' = H
II, R = C_6H_5, R' = CH_3, R'' = H
III, R = C_6H_5, R' = C_3H_7, R'' = H
IV, R = R' = — $(CH_2)_5$ —, R'' = H
V, R = C_4H_9, R' = C_2H_5, R'' = CH_3

Type A



VI, R = C_6H_5, R' = C_2H_5
VII, R = R' = — $(CH_2)_5$ ——

Type B

ISOMER DISTRIBUTION IN THE PARTIAL OXIMATION OF KETONES

(L. C. Card No. Mic 58-948)

Betty Baum Lubitz, Ph.D.
University of Michigan, 1957

The purpose of this study was to test the generally held assumption that the ratio of isomeric oximes formed during oximation of a ketone remains the same throughout the entire duration of the reaction. Any change in ratio would be evidence for a kinetically-controlled stage in oxime formation, as opposed to rapid equilibration between isomeric oximes.

Phenyl 2-pyridyl ketone and phenyl o-tolyl ketone were treated with hydroxylamine hydrochloride in aqueous methanol and aqueous ethanol respectively; sodium acetate was present as catalyst. The reactions were allowed to proceed for sufficient time to accomplish partial oximation only. The reaction mixtures were analyzed by infrared spectroscopy for degree of oximation, utilizing the -OH absorption band of the oxime. The ratio of oxime isomers was determined, utilizing the 10.63 μ band of syn-phenyl 2-pyridyl ketoxime and the 10.78 μ band of the anti-isomer, and found to be constant throughout the reaction at 65.6: 34.4. The values were checked by making use of the ultraviolet absorption maximum at 335 mμ of the nickel complex ion formed from the syn-isomer. The isomer ratios for phenyl o-tolyl ketone were not determined absolutely, but their constancy could be established by infrared

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spectrophotometry. It is concluded that rapid equilibration between isomers exists during oximation, and that the isomer ratio is therefore not kinetically controlled; the dehydration step is thus presumably not rate-determining.

Unsuccessful attempts to find conditions suitable for a kinetic study of the isomerization of syn-phenyl 2-pyridyl ketoxime to the anti-isomer, and vice-versa, are described. Attempted isomerizations in sulfuric acid over a range of concentrations and temperatures were always accompanied by sulfonation, Beckmann rearrangement, or hydrolysis.

Ultraviolet absorption maxima for the complex ions formed between syn-phenyl 2-pyridyl ketoxime and nickel, ferrous, cobaltous and cupric ions were found to be 335, 540, 330, and 350 mμ, respectively. The nickel complex was most suitable for quantitative estimation of the syn-oxime.

Theoretical consideration of the kinetic salt effect suggests that the rate-determining step in the formation of oximes in non-basic solution, as well as phenylhydrazones and semicarbazones, is probably between two neutral molecules, and not between a neutral molecule and an ion as has heretofore been supposed. 126 pages. $2.00.

PREPARATION OF COMPOUNDS OF POTENTIAL PHYSIOLOGICAL ACTIVITY: DERIVATIVES OF BENZILIC, SUBSTITUTED ACETIC AND SUBSTITUTED GLYCOLIC ACIDS AND SUBSTITUTED BUTANONES

(L. C. Card No. Mic 58-1324)

Thomas Alexander Magee, Ph.D.
University of Tennessee, 1957

Major Professors: C. A. Buehler and H. A. Smith

Several compounds have been prepared in order to investigate their physiological activity. All of these are derivatives of benzilic, disubstituted glycolic and acetic acids or of the analogously substituted 2-butanones.

The following compounds were prepared in the course of this research.

(1) 2-N,N-Dimethylaminoethyl phenylcyclohexylglycolate hydrochloride.
(2) 2-N-Piperidinoethyl phenylcyclohexylglycolate hydrochloride.
(3) 2-N-Piperidinoethyl phenylcyclohexylglycolate methyl bromide.
(4) 2-N,N-Dimethylaminoethyl dicyclohexylglycolate hydrochloride.
(5) 2-N-Piperidinoethyl dicyclohexylglycolate hydrochloride.
(6) 2-N-Piperidinoethyl 4,4'-dimethoxybenzilate hydrochloride.
(7) 2-N-Piperidinoethyl 4,4'-dimethoxybenzilate methyl bromide.
(8) 2-N,N-Dimethylaminoethyl phenylcyclohexylglycolamide hydrochloride.
(9) 2-N-Piperidinoethyl phenylcyclohexylglycolamide hydrochloride.
(10) 2-N,N-Dimethylaminoethyl dicyclohexylglycolamide hydrochloride.
(11) 2-N,N-Diethylaminoethyl dicyclohexylglycolamide hydrochloride.
(12) 2-N-Piperidinoethyl dicyclohexylglycolamide hydrochloride.
(13) 2-N,N-Dimethylaminoethylmethyl benzilamide hydrochloride.
(14) 2-N-Piperidinoethylmethyl benzilamide hydrochloride.
(15) 2-N,N-Dimethylaminoethylmethyl phenylcyclohexylacetamide hydrochloride.
(16) 2-N-Piperidinoethylmethyl phenylcyclohexylacetamide hydrochloride.
(17) 2-N,N-Dimethylaminoethyl thiolbenzilate hydrochloride.
(18) 2-N,N-Diethylaminoethyl thiolbenzilate hydrochloride.
(19) 2-N-Piperidinoethyl thiolbenzilate hydrochloride.
(20) 1,1-Diphenyl-1-hydroxy-4-N,N-dimethylaminobutanone-2 hydrochloride.
(21) 1-Phenyl-1-cyclohexyl-4-N,N-dimethylaminobutanone-2 hydrochloride.
(22) 1-Phenyl-1-cyclohexyl-4-N-piperidinobutanone-2 hydrochloride.

Krapcho, Turk, and Pribyl have reported the previous preparation of 13 and 14. However, the melting points listed by these authors differ from those found in the present work.

The previously unreported ketone, 1-phenyl-1-cyclohexylpropanone-2, was prepared for use as an intermediate. Its oxime and 2,4-dinitrophenylhydrazone are also reported.

Incomplete preliminary pharmacological testing indicates that compound 14 is more active than atropine in preventing mortality from a standard dose of an anticholinesterase compound. Compound 2 appears to be the most active antispasmodic. 147 pages. $2.00.

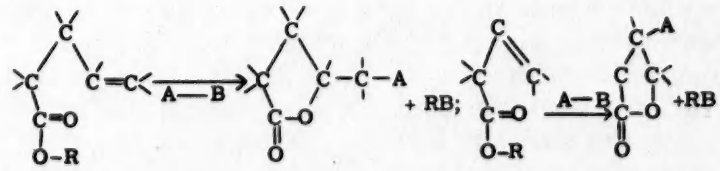
THE PARTICIPATION OF A NEIGHBORING CARBOXYL GROUP IN ADDITION REACTIONS

(L. C. Card No. Mic 58-1159)

Walter Peter Miller, Ph.D.
University of Minnesota, 1957

Major Adviser: Stuart W. Fenton

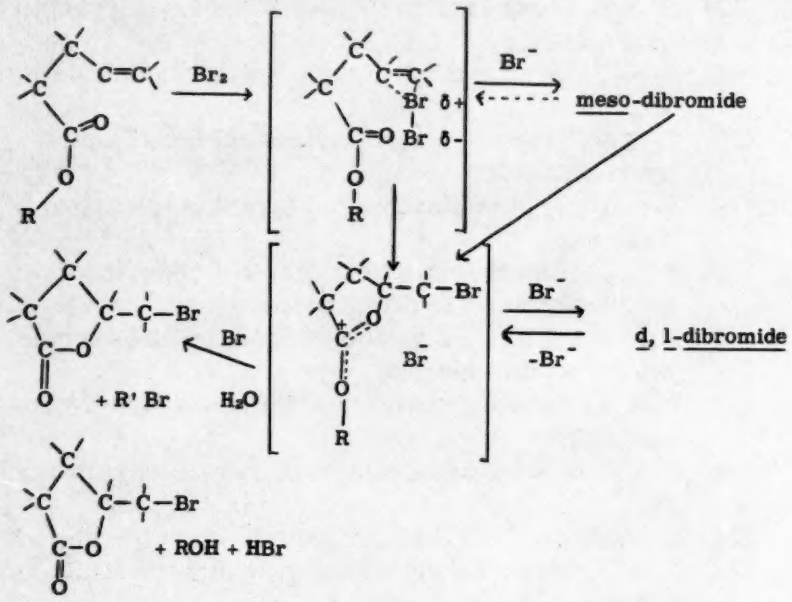
The purpose of this work was to investigate the scope and mechanism of the participation of neighboring carboxyl groups in addition reactions of the following type:



Bromination reactions were chosen for a detailed study of this process.

The evidence obtained was entirely consistent with the following mechanism for bromolactone formation.

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This mechanism was formulated on the basis of the evidence available in the literature and the following results obtained in the present investigation:

1. Structural Factors: The investigation of the bromination of methyl nopylcarboxylate, methyl Δ^2-cyclohexenylacetate, methyl allyldiphenylacetate and methyl 2-stilbenecarboxylate showed that the ease and direction of lactonization is controlled by steric and electronic factors with the steric ones playing the most important role.

2. Electrophilic Reagents: In addition to the wide variety of reagents previously reported to have been used to lactonize β, ν- and ν, δ-unsaturated acids and esters, the following reagents were also found to initiate this reaction: N-bromosuccinimide, t-butyl hypochlorite, and benzenesulfenyl chloride.

3. Reaction Conditions: a) An increase in the polarity of solvents was found to decrease the rate of methyl bromide formation. b) Addition of alkyl bromides or iodides was found to increase the rate of methyl bromide formation. c) In one case, the presence of a Lewis acid, aluminum bromide, was found to increase the ease of lactonization.

4. Existence of an Unstable Intermediate: a) Rate of methyl bromide evolution was found to be slow, although a stoichiometric amount could be obtained. b) Bromination followed by extraction with water or reaction with water present in a non-anhydrous solvent was found to yield bromolactone, an alcohol and hydrogen bromide. c) The formation of bromolactone from methyl 2-stilbenecarboxylate was found to be a slow process as indicated by infrared spectra, although with methyl allyldiphenylacetate only inconclusive results could be obtained. d) Ultraviolet spectra showed that the rate of bromine uptake by methyl allyldiphenylacetate is a slow process in very dilute solutions. e) The change of rotation of (-)-menthyl allyldiphenylacetate when halogenated showed an initial sharp decrease followed by a slow decrease in rotation, indicating the presence of an unstable intermediate.

5. The Structure of the Intermediate: The intermediate isolated from the bromination of methyl 2-stilbenecarboxylate was shown to be the d,l-dibromoester by its physical and chemical properties.

6. Steric Control in the Bromination Reaction: The bromination of methyl trans-2-stilbenecarboxylate quantitatively yielded the d,l-dibromoester, which is only slightly contaminated with the meso isomer. The bromination of trans-2-stilbenecarboxylic in acetic acid or chloroform yielded the insoluble meso-dibromoacid and the bromolactone. 237 pages. $3.10.

THE BENZOCYCLOBUTENE SYSTEM

(L. C. Card No. Mic 58-555)

Donald Ray Napier, Ph.D.
The Ohio State University, 1957

The reaction of a,a,a',a'-tetrabromo-o-xylene and sodium iodide, first carried out by H. Finkelstein and reported by him as giving 1,2-dibromobenzocyclobutene, has been repeated and confirmed. In addition to the dibromide, two other substances were isolated, namely, 1,2-diiodobenzocyclobutene and a compound $C_{16}H_{12}BrI_3$. The latter appears to be a derivative of 1,2,4,5-dibenzcyclooctadiene. The diiodide was shown to be a secondary reaction product arising from the further reaction of iodide ion with the initially formed dibromide. Mechanisms for the formation of these compounds are discussed.

Zinc dehalogenation of either dihalide gave the unstable benzocyclobutadiene, isolated only as a dimer in yields of 70-80 per cent. On the basis of aromatization evidence, the dimer is assigned the structure of 6a, 10a-dihydrobenzo-[a]-biphenylene. Catalytic reduction of the diiodide gave the parent hydrocarbon, benzocyclobutene, in 55 per cent yield. Benzocyclobutene, b.p. 150° (748 mm.), is quite stable thermally; however, it is somewhat sensitive to strong acids – especially hydrogen fluoride. Bromination of the hydrocarbon with N-bromosuccinimide gave 1-bromobenzocyclobutene in 58 per cent yield. This monobromide may be employed as an intermediate for the preparation of other mono-substituted derivatives, specifically the nitrile, carboxamide, carboxylic acid, and the aminomethyl derivative.

Both the dibromide and diiodide appear to be incapable of undergoing either solvolysis or Walden inversion-type reaction. However, both dihalides react readily with silver salts to give the expected oxygenated derivatives in high yield. Reaction of the diiodide with silver nitrate gave a mixture of the cis and trans 1,2-dinitrate esters, isolated in yields of 27 per cent and 44 per cent respectively. These dinitrates react exothermically with potassium t-butoxide to give 3-t-butoxyphthalide. When treated with a methylene chloride solution of triethyl amine, the dinitrates are converted to 1,2-diketobenzocyclobutene in 75 per cent yield. This pale yellow substance is quite stable thermally. It was characterized by conversion (94 per cent) to phthaldehydic acid with sodium hydroxide and oxidation to phthalic acid (100 per cent) with peracetic acid.
101 pages. $2.00.

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AN INVESTIGATION DIRECTED TOWARDS THE SYNTHESIS OF QUINODIMETHANE DERIVATIVES

(L. C. Card No. Mic 58-1135)

Dean Arthur Ostlie, Ph.D.
University of Minnesota, 1957

Major Adviser: Stuart W. Fenton.

A number of investigators (1-11) have tried unsuccessfully to isolate p-quinodimethane (I) or its mono- or dibenzo derivatives. Hagemeyer (1) has reported its preparation, but two other groups of workers (2,3) and this investigator failed in an effort to repeat his work.

This present work was directed toward the synthesis of quinodimethane derivatives by such methods as the dehydration of 9,10-dihydroxy-9,10-dimethyl-9,10-dihydroanthracene (II) and 9,10-dihydroxy-9,10-dimethyl-9,10-dihydrophenanthrene (III) or by the reaction of ketene with para-quinones as reported by Hagemeyer (1).

All attempts to repeat Hagemeyer's procedure failed, as only red oils and tars were obtained.

It was found that dehydration of III with maleic anhydride yielded only 10,10-dimethyl-9-phenanthrone (IV), and that dehydration with acetyl chloride yielded mainly IV plus a small amount of a chlorine-containing product believed to be 9-methyl-10-chloromethylphenanthrene(V).

The dehydration of II with maleic anhydride yielded a mixture of products that were not identified.

When II was dehydrated with acetic anhydride, a yellow, amorphous powder was obtained which was similar to the product obtained by Guyot and Staehling (11) when they treated II with acetic anhydride.

The reaction of II with acetyl chloride or acetyl bromide resulted in the formation of 9-methyl-10-chloromethylanthracene (VIII) and 9-methyl-10-bromomethylanthracene (IX), respectively.

The dehydration of II with iodine resulted in the formation of 9,10-dimethylanthracene (X), tetrabenzo-di-p-xylylene (XI) and other unidentified products.

The structure of tetrabenzo-di-p-xylylene was determined from the analysis, molecular weight, ultraviolet spectrum, comparison with 1,2-bis(10-methyl-9-anthryl)-ethane (XII), and its dehydrogenation products.

When tetrabenzo-di-p-xylylene was dehydrogenated with sulfur, two products were obtained which were assigned the structures 5,6:11,12:13,14:15,16-tetrabenzotricyclo[8.2.2.2^{4,7}]-2,4,6,10,12,13,15-hexadecaheptaene (XIII) and 5,6:11,12:13,14:15,16-tetrabenzotricyclo [8.2.2.2^{4,7}]-2,4,6,8,10,12,13,15-hexadecaoctaene (XIV).

The ultraviolet spectra of XIII and XIV had undergone a bathochromic shift of 500Å and 1000Å, respectively, and the extinction coefficient had been reduced approximately one-half as compared to the spectrum of tetrabenzo-di-p-xylylene (XI). The ultraviolet spectrum of 1,2-bis(10-methyl-9-anthryl)-ethylene (XV) also showed a bathochromic shift of 500Å and a reduction of the extinction coefficient by one-half as compared to XII.

The preparation of 1,2-bis(10-methyl-9-anthryl)-ethane (XII) was accomplished by the reaction of methylmagnesium iodide and 9-methyl-10-chloromethylanthracene (VIII). However, along with this product, there was obtained an isomeric material believed to be an internal anthracene dimer of XII, which was assigned the structure 2,3:6,7;11,12:13,14-tetrabenzo-4,5-dimethylbicyclo [0.2.6.2^{1,4}.2^{5,8}]-tetradecane (XVI).

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SYNTHESES AND REACTIONS OF AZAAZULENES

(L. C. Card No. Mic 58-1091)

Harry Francis Richards, Ph.D.
University of Washington, 1957

An investigation of the syntheses and reactions of azaazulenes was initiated in order that the chemical and physical properties of the azaazulenes obtained might be examined and compared with those of the corresponding known azulenes. The results help to clarify the requisite structural features for aromatic character in bicyclic 10 π-electron, tricyclic 14 π-electron, tetracyclic 18 π-electron and pentacyclic 22 π-electron systems. This investigation is divided into three parts: attempted syntheses of 1-azaazulenes and 1,3-diazaazulenes; electrophilic substitution of cyclohept[b]indole; attempted synthesis of 1-aza-8-methyldibenz[b,g]azulene.

PART I

Condensation of sodium isonitrosocycloheptanone and acetoacetic ester in the presence of zinc and acetic acid gave 2-methyl-3-carbethoxy-1,4,5,6,7,8-hexahydrocyclohept[d]-pyrrole. Employment of cycloheptanone with isonitrosoacetoacetic ester and isonitrosobenzoyl acetate gave 2-carbethoxy-3-methyl- and 2-carbethoxy-3-phenyl-1,4,5,6,7,8-hexahydrocyclohept[d]pyrrole respectively. Unstable red oils were obtained when the above products were saponified and decarboxylated. Attempted dehydrogenations failed to yield the desired azaazulenes. Dehydrogenation did occur but the starting materials and products were unstable and decomposed into polymeric red oils.

2-Carbethoxy-3-methylcyclohept[d]pyrrole and 2-carbethoxy-3-phenylcyclohept[d]pyrrole were obtained in low yields from the chloranil dehydrogenation of the corresponding hexahydro compounds. They were found to be quite unstable red oils and were characterized only by their spectra and basicity.

Attempted dehydrogenation of 2-methyl-1,4,5,6,7,8-

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hexahydrocyclohept[d]imidazole, prepared from cycloheptane-1,2-dione, acetaldehyde and ammonia, failed to yield 2-methyl-1,3-diazaazulene. Spectral evidence was obtained for the formation of 3-phenyl-1,3-diazaazulene. It was concluded that the intermediate imidazoles do not readily dehydrogenate, but when dehydrogenation does occur the products are very unstable and decompose in the reaction medium.

The relative instability of 1-aza- and 1,3-diazaazulenes would seem to indicate that the stability of azulene is primarily associated with the 10 π-electron resonance system rather than the combination of a tropenium ring and an allyl carbanion structure. Because of similar findings by other workers, further investigations of 1-aza- and 1,3-diazaazulenes were abandoned.

PART II

The aromatic character of cyclohept[b]indole has been investigated and electrophilic substitution of the molecule has been achieved. Mono-nitration occurred in good yields and the proof of the position of electrophilic attack was a challenging one.

2-Nitro- and 4-nitro-5,6,7,8,9,10-hexahydrocyclohept-[b]indole were synthesized. Dehydrogenation of the 2-nitro-compound with chloranil was unsatisfactory. The 2-amino-, 2-N-acetylamino-, 4-amino- and 4-N-acetylamino-5,6,7,8,9,10-hexahydrocyclohept[b]indoles were prepared and the hydrogenation of the nitration product of cylcohept [b]indole gave a product which was quite unstable. Attempted purification of its acetyl derivative failed; however, its infrared spectrum was almost identical with that of 2-N-acetylamino-5,6,7,8,9,10-hexahydrocyclohept[b]indole. It was concluded that a side reaction was occurring during hydrogenation which prevented purification of the product.

Partial hydrogenation of the nitrocyclohept[b]indole with 3 moles of hydrogen reduced the ring unsaturation and not the nitro group. The product was easily separated from tarry side products by means of chromatography. It was found to be identical with 2-nitro-5,6,7,8,9,10-hexahydrocyclohept[b]indole. Therefore electrophilic substitution occurred at the 2-position of cyclohept[b]indole.

Acetylation of cyclohept[b]indole was carried out. Spectral evidence, that acetylation had occurred, was obtained. However, not enough material was obtained for further identification and characterization.

Attempted formation of cyclohept [b] indole-5-oxide failed. Hydrogen peroxide and acetic acid gave complete oxidation of the azaazulene nucleus.

PART III

In contrast to the observations with mono- and dibenz-1-azaazulenes, 1-azatribenz[b,e,g]azulene is not formed by the dehydrogenation of 1,8-dihydro-1-azatribenz [b,e,g,] azulene with chloranil.

Addition of methylmagnesium iodide to 5H-8,9-dihydrocycloheptabenzen-5,6(7H)-dione followed by reduction with zinc, acetic acid and hydrochloric acid gave a mixture of 6H-5-methyl-5,7,8,9-tetrahydrocycloheptabenzen-6-one and 7H-5,6-dimethyl-8,9-dihydrocycloheptabenzene. The structure of the former was proven by its ultraviolet and infrared spectra, elemental analysis, analysis of a D.N.P. derivative and by comparison with the other possible isomer 5H-6-methyl-6,7,8,9-tetrahydrocycloheptabenzen-5-one, which was synthesized from 5H-6-carbethoxy-6,7,8,9-tetrahydrocycloheptabenzen-5-one. The latter was identified by analysis and spectral studies.

Condensation of 6H-5-methyl-5,7,8,9-tetrahydrocycloheptabenzen-6-one with phenylhydrazine in acid gave the corresponding indoline product in good yield. No indole product was isolated. The Fischer indole synthesis also failed on 2-methylcycloheptanone. The mechanism of the Fischer reaction was used as the basis for possible reasons for the failure of above syntheses. 163 pages. $2.15.

STUDIES ON THE MAILLARD REACTION; APPLICATION OF RADIOCHEMICAL TECHNIQUES

(Publication No. 25,418)

Raymond Charles Schlicht, Ph.D.
The Ohio State University, 1952

INTRODUCTION

The Maillard reaction (1) involves the interaction of sugars and amino acids, usually found together in foods, either in their free states or as hydrolyzable polysaccharides and proteins. The intensely brown, high molecular weight reaction products, the Maillard polymers, are in a few instances desirable in foods, but generally they are not, not only because of discoloration but also because of the concomitant loss of palatability and decrease in nutritional value. Since the military services are interested in the dehydration or concentration of foodstuffs, the Food and Container Research Institute for the Armed Forces has carried out and supported research to find effective means to combat the browning problem that results from the Maillard reaction. The dissertation was financed by the Institute under the auspices of the Ohio State University Research Foundation, and is primarily a discussion of the nature of the structure of the Maillard polymer, which heretofore has not been elucidated. Since the usual degradative procedures employed in structure determination have failed to produce any significant results when applied to Maillard polymers, glycine and various sugars containing radioactive carbon-fourteen in specific positions were employed to find the inter-relationships between the atoms of these compounds in the polymers. This particular modification in radiochemical tracer techniques is not known to have a precedent in chemical literature.

EXPERIMENTAL

Maillard reactions were carried out employing radioactive D-glucose-1-C^{14}, D-xylose-1-C^{14}, and L-arabinose-1-C^{14} with inactive glycine, and radioactive glycine-1-C^{14} and glycine-2-C^{14} separately, with each inactive sugar. Some of the radioactive glycine experiments had been carried out by Langer (2) under identical conditions and were therefore not repeated. The reaction procedure was to heat aqueous solutions, 0.125 M in sugar and 1.25 M in glycine, at 95°C. for 90 hours. For each of the three sugar-glycine systems, nitrogen was bubbled through the reaction mixtures. In addition, other pentose-glycine reaction mixtures were aerated with carbon dioxide-free air. The entrained carbon dioxide was collected as barium carbonate after having been washed by a 50 per cent sulfuric acid solution. The final reaction mixtures were dialyzed so as to retain those

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TABLE I

COUNTING DATA

Experiments Employing Nitrogen Atmospheres

Reaction of Glycine with	Observable Activities (counts/min./mg.) Sugar -1-C^{14}	Glycine -1-C^{14}	Glycine -2-C^{14}	Polymer	Per Cent C^a in Polymer	$BaCO_3$ [b] Activity
A. D-Glucose						
1.	629	--	--	613	55.4	966
2.	--	--	2506	1120	53.7	0
3. (a)	--	1925	--	413	53.8	7810
(b)	--	332	--	--	--	1795
B. D-Xylose						
1.	589	--	--	629	58.5	980
2.[c] (a)	--	2268	--	388	59.1	10,780
(b)	--	1827	--	314	--	9,590
3.[c] (a)	--	--	2541	1400	59.1	0
(b)	--	--	2569	1442	--	0
C. L-Arabinose						
1.	--	2212	--	380	56.9	9,950
2.	796	--	--	794	58.7	1,372
3.[c]	--	--	2422	1386	59.8	0
Experiments Involving Aeration						
A. L-Arabinose						
1. (a)	633	--	--	412	52.9	38,500
(b)	627	--	--	391	--	35,600
B. D-Xylose[c]						
1.	--	2233	--	598	53.9	10,570
2.	--	--	2569	2324	55.8	385

a. All analyses by Huffman Microanalytical Labs., Denver, Colorado. Percentages are not on an ash-free basis, thus allowing for the inorganic material in the sample counted.

b. The activity of the barium carbonate from labeled glycine is reported as the number of counts/min. for an "infinitely thick" circular sample, 20 mm. in diameter. The activity of the barium carbonate from the labeled sugars is reported as the maximum activity (counts/min.) calculated for the entire yield of barium carbonate at "infinite thinness."

c. Reactions carried out by Langer (2); sample activities counted by Professor Varner (3).

products having molecular weights in excess of 10,000. The non-dialyzable polymers were precipitated by the addition of absolute dioxane to the dialyzed polymer solution which had previously been concentrated under reduced pressure. The polymers were washed successively with absolute ethanol, acetone, and ether by centrifugation, and were then dried for 20 hours at 56°C. in vacuo over phosphorus pentoxide. The barium carbonate was filtered and washed with boiling water, alcohol, and acetone under a nitrogen jet, and dried in a 100°C. oven for 20 hours.

The counting procedure was to determine with a calibrated Landsverk electrometer (model L-75) the activities of the original reactant and of the polymer after plating approximately 10 mg. samples by evaporation of aqueous solutions on 40.0 mm. diameter lens paper discs mounted on aluminum cups. The barium carbonate samples were plated upon 47.0 mm. diameter aluminum cups by evaporation of a slurry with alcohol or absolute dioxane. The sample activities and carbon analyses are given in Table I. In Table II, the empirical formulas, maximum polymer yields obtained and barium carbonate yields from the reactions involving labeled sugars are given for each sugar-glycine system. These figures are the only other experimental values necessary to calculate the numerical values reported in Tables III, IV, and V.

The polymer and reactant plates, being of approximately equal sizes and weights, could be compared in activity

TABLE II

Other Essential Reaction Data

Polymer from Glycine and	Empirical Formulas[a] Nitrogen Basis C	H	O	N	Polymer Yields[b] (Grams per Mole of Sugar)	Essential Data from Tagged Sugar Experiments[c] Sugar-1 -C^{14} Used	$BaCO_3$ Yield
A. (Employing Nitrogen Atmospheres)							
D-Glucose	7.39	8.79	2.88	1	31.2	2.2500 g.	0.5320 g.
D-Xylose	7,65	8.54	2.52	"	56.5	0.9473	0.4173
L-Arabinose	7.77	8.41	2.61	"	44.5	0.7114	0.3214
B. (Employing Aeration)							
"Pentose"[d]	4.99	5.43	2.00	"	--	0.7531	1.6233

a. Analyses by Huffman Microanalytical Laboratories, Denver, Colorado.

b. Maximum yields obtained in three experiments run for each sugar-glycine system, including those experiments reported by Langer (2).

c. These are needed to calculate the percentage of the carbon dioxide coming from the sugar number-one carbons.

d. From the combined data of separate experiments employing D-xylose and L-arabinose.

without making any self-absorption corrections, by allowing only for the differences in carbon contents. The number of total carbons in the polymer for each labeled carbon might then be calculated. Comparison of these "dilution factors" for each type of labeled atom, and comparison with the nitrogen contents, resulted in the numerical relationships shown in Table III for these polymers.

TABLE III

Numerical Relationships in the Polymers

Polymer Functions	Polymers Prepared under Nitrogen D-Glucose-Glycine	D-Xylose-Glycine	L-Arabinose-Glycine	Polymers Prepared with Aeration "Pentose"-Glycine
Relative Numbers of				
A. Sugar #1C	1	1	1	1
B. Glycine CH_2	1.14	1.05[a]	1.13[a]	2.70[a]
C. Glycine CO_2H	0.544	0.322[a]	0.358	0.826[a]
D. Total Polymer Carbons	8.53	6.92	7.41	10.4
E. Nitrogens	1.15	0.972	0.953	2.08

a. From the experimental values reported by Langer (2).

The yields of sugar number-one carbon in the isolated polymers (see Table V) were calculated, using the observed activities, since the equally-sized polymer and sugar samples require practically identical self-absorption corrections. The observed and the maximum activities are then in the same proportion for both polymer and sugar samples.

Varner (3) experimentally derived for Langer (2) a factor, 1.32, which converts the observed activity of an "infinitely thick" (>20 mg./cm^2) barium carbonate sample on a 20.0 mm. diameter plate into the observable activity per

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TABLE IV

Empirical Formulas from Tracer Data

Polymer	Gas Employed	Derived Empirical Formulas
D-Glucose-glycine	N_2	$C_6H_6O_2(NCH_2)_{0.5}(NCH_2CO_2H)_{0.5}$
D-Xylose-glycine	"	$C_5H_4O(NCH_2)_{0.7}(NCH_2CO_2H)_{0.3}$
L-Arabinose-glycine	"	$C_5H_4O(NCH_2)_{0.7}(NCH_2CO_2H)_{0.3}$
"Pentose"-glycine	air	$C_7H_5O_{2-3}(NCH_2)(NCH_2CO_2H)(CH_2)_{0.6}$

mg. of labeled carbon in the original radio-glycine employed. The barium carbonate activity (calculated to glycine activity) was compared to the actually observed activity of the glycine, a difference owing to the inclusion of carbon dioxide from sources (see Table V) other than the particular labeled glycine carbon. The amount of carbon dioxide from the sugar number-one carbons (see Table V) was calculated by the use of self-absorption corrections (4), converting the observed activities of both the barium carbonate and the labeled sugar samples to their maximum activities. The product of the quantity of barium carbonate and the maximum specific activity is the amount of barium carbonate activity originating from the labeled sugar.

The empirical formulas of the sugar portions in the polymers were calculated by subtraction of those atoms associated with the glycine moieties from the empirical formulas for the polymers. Because of the equivalence (see Table III), within experimental accuracy, of the relative numbers of sugar number-one carbons, glycine methylene carbons, and nitrogens in the polymers prepared under nitrogen, the empirical formulas employed in the subtraction were based upon the glycine methylene content. Since those atoms were not equivalent (see Table III) in the polymers prepared by aeration of the reaction mixtures, the empirical formula employed was on a sugar number-one carbon basis. The data from both L-arabinose-glycine and D-xylose-glycine experiments employing air (reactions carried out by Langer (2) were combined to determine the nature of a pentose-glycine polymer, for the products were practically identical in elementary analysis, and the pentose-glycine polymers prepared under nitrogen were found to have a common polymer repeating unit.

THE DEFINITIVE TRACER RESULTS

The major contribution of these studies is the determination of a repeating structural unit for all three polymers prepared under a nitrogen atmosphere. It was calculated that the two pentose-glycine polymers had the same repeating unit of $C_5H_4O{\cdot}NCH_2(CO_2H)_{0.3}$, and that the D-glucose-glycine polymer had the unit $C_6H_6O_2{\cdot}NCH_2(CO_2H)_{0.5}$. The difference, CH_2O, between the two sugar residues can be explained by the presence in the D-glucose-glycine polymer unit of an additional -CHOH group, presumably as a hydroxymethyl group substituted for one of the hydrogens in the sugar residue of the pentose-glycine polymers. The chief difference between the hexose-glycine and the pentose-glycine polymers would seem to be the degree of decarboxylation of the initially formed sugar-glycine units. It should be pointed out (see Table V) that the yields of polymer did not exceed 40 per cent based upon the sugar number-one carbon contents. The polymer fractions for which repeating structural units have been calculated were thus not necessarily the major products.

The pentose-glycine polymers prepared by aeration of the reaction mixtures and the corresponding polymers prepared under the nitrogen atmosphere differed primarily by the inclusion in the former of a greater number of glycine moieties per sugar number-one carbon. The polymer unit per sugar number-one carbon was calculated to be $C_7H_5O_{2-3}(NCH_2CO_2H)(NCH_2)(CH_2)_{0.6}$.

TABLE V

Reaction of Glycine with	Gas Employed	Per Cent of the Total Carbon Dioxide from			Per Cent of Sugar #1-C Recovered in Polymer
		Sugar #1-C	Glycine CH_2	Glycine CO_2H	
D-Glucose	N_2	0.20	0	114	16
D-Xylose	"	0.33	0[a]	100[a]	40
L-Arabinose	"	0.34	0[a]	95	29
D-Xylose	air	--	3[a,b]	100[a]	
L-Arabinose	air	3	--	--	20

a. Reported by Langer (2).
b. Somewhat in doubt since a sulfuric acid wash solution from a previous tracer experiment was re-employed.

The only significant source of carbon dioxide for all three sugar-glycine systems studied was the glycine carboxyl group, both when a nitrogen atmosphere was employed and when the reaction mixtures were aerated.

Speculation on the Possible Means of Formation and the Nature of the Polymer Repeating Unit.

The equivalence of the numbers of sugar and glycine atoms in the polymers further supports the conclusion generally drawn that the first step of the Maillard reaction is the interaction of the sugar carbonyl group and the amino group of the amino acid. The first intermediate, either a Schiff's base or an N-glycosyl-amino acid, must react further so that the nitrogen becomes firmly bound to the sugar. This might be explained by an Amadori rearrangement or by a polymerization involving these atoms.

The mechanism of the decarboxylation still cannot be elucidated. Langenbeck's (5) Strecker degradation mechanism would require the sugar to oxidize the glycine to formaldehyde, ammonia, and carbon dioxide. Incorporation of the ammonia and the formaldehyde into the polymer by secondary reactions would probably not result in a 1:1:1 relationship between the relative numbers of sugar number-one carbons, glycine, methylenes, and nitrogens. This mechanism also requires that the reaction in the absence of oxygen be stopped after 50 per cent decarboxylation (based upon the sugar consumed) because of the formation of a quinhydrone, as in the following reaction:

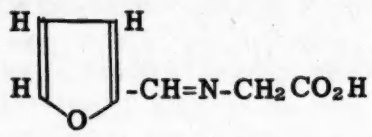
$$2\begin{array}{l}-C{=}O\\ \\ -C{=}O\end{array} + H_2NCH_2CO_2H \xrightarrow{H_2O} \begin{array}{l}-C{=}O\ HO{-}C-\\ \quad\cdot\quad\quad |\\ -C{=}O\ HO{-}C-\end{array} + CO_2 + NH_3 + CH_2O.$$

If there is an undissociated "quinhydrone" which is converted to the polymer, it would have to be a nitrogen analog having an attached methylene group to satisfy the observed polymer structure. The Strecker mechanism would require that one of these methylenes still would have the carboxyl attached, since only one of the dicarbonyl molecules is reduced. Then by this Strecker degradation mechanism the polymer would have only 50 per cent of the glycine moieties decarboxylated. Since it was calculated from the tracer results that the pentose-glycine polymers contained glycine moieties about 70 per cent decarboxylated, the Strecker degradation again does not seem to be

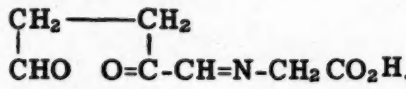
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involved. If the "quinhydrone" were dissociated before polymerization, then the reaction should be able to continue beyond 50 per cent decarboxylation.

The nature of the repeating units of the polymer is still obscure. It is assumed that the hexose-glycine and the pentose-glycine polymers are polymerized in the same fashion. The following compound may be the original monomer for the pentose-glycine polymer.



The two free valencies which are the minimum number in a polymer unit might be attached to the polymer unit in the fashion shown by the opening of any one double bond, or opening across the 1,4 or 1,6 systems with double bond shifts. This polymerization would result in a shortening of the conjugated system of each unit. A type of condensation polymerization reaction whereby long conjugated systems would be expected to form might be the aldol condensation of an intermediate originally containing the atoms in the polymer unit and the elements of one mole of water. One possible intermediate for the pentose glycine polymers might be the following:



The formation of fairly long conjugated systems might be expected since the polymers are so intensely brown in color.

The methylene groups, after decarboxylation, cannot be converted entirely to N-methyl groups, since Langer (2) found that a D-xylose-glycine polymer prepared under the same conditions as employed in these tracer studies contained only 0.05 of an $N\text{-}CH_3$ per nitrogen atom. The methylene carbon valencies remaining after decarboxylation might be satisfied either by some reaction within the polymer unit not involving N-methyl formation, or by cross-linking of polymer units. The latter possibility might explain the high molecular weight of the isolated polymer.

The pentose-glycine polymers prepared by aeration of the reaction mixture contained more glycine moieties than one per sugar number-one carbon. A 1:1 pentose-glycine polymer unit might first be formed as in the reaction under an inert atmosphere. The air oxidation might then produce functional groups (perhaps conjugated or α-dicarbonyls) which are capable of combining with and decarboxylating other glycine molecules. Langer (2) found that a D-xylose-glycine polymer, previously prepared under nitrogen, is capable of decarboxylating glycine when the reaction mixture is aerated.

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Abstract published by special arrangement with The Ohio State University.

REACTIONS OF DIBENZO[2.2.2]BICYCLOÖCTADIENECARBOXYLIC ACIDS

(L. C. Card No. Mic 58-985)

Arnold Charles Schoenthaler, Ph.D.
University of Michigan, 1956

The main purpose of this investigation was to synthesize and study the behavior of 3-bromodibenzo[2.2.2]bicycloöctadiene-trans-2-carboxylic acid (A), 3-bromodibenzo-[2.2.2]-bicycloöctadiene-cis-2-carboxylic acid (B), and 2- bromodibenzo-[2.2.2]bicycloöctadiene-2-carboxylic acid (C) when treated with nucleophilic and electrophilic reagents such as aqueous potassium hydroxide and silver nitrate in aqueous acetone. A secondary purpose was to determine if migration of the 3-methyl group occurred during, or prior to, the acid-induced rearrangement of 3-methyl-2-hydroxydibenzo[2.2.2]bicycloöctadiene-trans-2, 3-dicarboxylic acid (D) to 2-exo-hydroxy-6-methyl-3,4,7,8-dibenzo [3.2.1] bicycloöctadiene-1-cis-6-dicarboxylic acid-2,6-lactone (E).

Compounds A and C were synthesized by means of the Diels-Alder reaction between anthracene and trans-β-bromoacrylic, and α-bromoacrylic acid, respectively. Compound B was obtained from the stereospecific trans addition of hydrogen bromide to dibenzo[2.2.2]bicycloöctatriene-2-carboxylic acid. The assigned structures are supported by the nature of the Wagner-Meerwein rearrangement product afforded by each.

The results obtained with basic reagents show that cis dehalogenative decarboxylation (presumably by a two-step ionization process) and trans dehydrohalogenation are favored. The geometry of the bicyclic ring system inhibits dehalogenative decarboxylation and β-lactone formation in A and the major product is a hydroxy acid arising from a completely stereospecific Wagner-Meerwein rearrangement. With C, a similar rearranged hydroxy acid is the sole product.

When silver nitrate is the attacking reagent, rearrangement is the exclusive means of reaction for A and C; with B, a small amount of dehalogenative decarboxylation product is observed. Under these conditions, the rearrangement is stereospecific only as far as the carbon skeleton is concerned, the existence of epimers about the carbon atom bearing the hydroxyl group is clearly detectable.

The complete retention of optical activity in the rearrangement of (-)-D to (+)-E proves that migration of the methyl group is not a factor in this reaction. 141 pages. $2.00.

PART I: SYNTHESIS OF SUBSTITUTED LINEAR PHENOL-FORMALDEHYDE POLYMERS. PART II: POLYMERIZATION OF ISOPROPOXYMETHYLPHENOLS.

(Publication No. 20,044)

Glen A. Short, Ph.D.
University of Utah, 1956

Chairman: W. J. Burke

PART I

Linear high molecular weight polymers were prepared by the condensation of p-cresol and 2,6-bis-(2-hydroxy-5-methylbenzyl)-4-chlorophenol (trimer) with formaldehyde. The trimer, p-cresol, and formaldehyde were used in a ratio 1:3:4 in order to obtain products having at least two and an average of five p-cresol residues between each of the p-chlorophenol residues.

The nature of the polymeric products was found to be dependent on the surface area of the reaction mixture, the relative volume of the gaseous phase to that of the reactants, and the particular gas above the liquid phase.

Evidence was obtained to indicate that the formation of insoluble and high molecular weight material in tubes having large surface area or a large gaseous volume is probably due to reaction of the surface polymer with formaldehyde which is mechanically trapped in the gaseous phase of the tube. Shaking a tube during polymerization reduced the surface effect and made possible the preparation of a higher molecular weight polymer with very little insoluble material being formed.

The data obtained from variation of gas in the tubes pointed to the reaction of oxygen with the polymer. Reactions were proposed to explain the existence of soluble, high molecular weight, colored polymers in the surface layer.

Over the ranges studies, longer time, higher temperature, and a lower amount of solvent favored higher molecular weight products.

A polymer having a p-chlorophenol residue as every third ring of the chain was obtained by condensing 2,6-bis-(2-hydroxy-5-methylbenzyl)-4-chlorophenol and formaldehyde.

Elemental analysis and infrared spectra were found to be consistent with the linear structures proposed. The original polymers showed absorption bands characteristic of associated hydroxyl groups (2.95 to 3.2 microns), 2,4,6 substituted phenols (11.65 microns), and a weak band for 2,4 substitution at 12.3 microns.

Dehalogenation of the polymers to give free para positions in place of the chlorine groups was accomplished by use of sodium in a solution of liquid ammonia and tetrahydrofuran. Infrared spectra of these dehalogenated polymers showed new bands at 13.3, 12.0 and 10.4 microns, characteristic of 2,6 substitution, in addition to those identified above.

PART II

4-Chloro-2-isopropoxymethylphenol was prepared in 47% yield by the reaction of 4-chloro-2-dimethylaminomethylphenol methiodide with sodium isopropoxide in isopropyl alcohol. A systematic study of the polymerization of this new monomer showed that it could be readily converted to a linear high molecular weight p-chlorophenol-formaldehyde polymer in the presence of p-toluenesulfonic acid as a catalyst. Contrary to results obtained earlier in alternate syntheses of such polymers, completely soluble products were obtained without the use of an added solvent.

In a closed system the polymerization of this monomer resulted in the formation of 63 mole % of isopropyl alcohol, 24 mole % of water, and no formaldehyde. The formation of isopropyl alcohol was associated with the attack of either a hydroxybenzyl carbonium ion or an o-quinone methide on a free ortho position to form a methylene bridge. Accordingly, the major portion of the polymerization proceeded by one or a combination of these two routes.

Since benzyl ether structures were shown to be absent in the polymer, any such linkages formed as intermediates, presumably, were converted to methylene bridges with the loss of formaldehyde. The absence of formaldehyde indicated that all of this compound reacted with free ortho positions to form methylene bridges and water. Thus, the amount of water found gave a measure of the extent to which the monomer reacted to form benzyl ether linkages.

In an open system, the polymerization was accompanied by the formation of 66 mole % of isopropyl alcohol, 18 mole % of isopropyl ether, 16 mole % water, 4 mole % of formaldehyde, and 2 mole % of 5-chlorosalicylaldehyde. Thus, in the main, the course of the polymerization in the open system did not differ greatly from that in a sealed tube. The formation of the aldehydes provides a logical explanation for the fact that lower molecular weight products were obtained in the open system.

2,4-Dichloro-6-isopropoxymethylphenol was pyrolyzed in an attempt to provide additional information concerning the mechanism of direct methylene bridge formation. Isopropyl alcohol and products depending upon benzyl ether formation were isolated in amounts comparable to those obtained from the polymerization of 4-chloro-2-isopropoxymethylphenol. These results appear to support the view that quinone methides are important intermediates in phenol-formaldehyde condensations.

78 pages. $2.00. Mic 58-4798

AZULENE STUDIES: AN IMPROVED SYNTHESIS; DERIVATIVES OF 1-PHENYLAZOAZULENE; SPECTRA AND DIPOLE MOMENTS OF CERTAIN AZULENES

(L. C. Card No. Mic 58-1095)

Bernard Michael Steckler, Ph.D.
University of Washington, 1957

In accord with the extensive program of study suffered by the field of azulene chemistry since it originally became of interest to workers in the general problem of correlating chemical structure with aromaticity, the present research began with attempts to improve the conditions for the synthetic approach leading to the parent compound.

Preliminary studies of syntheses from indane with ethyl diazoacetate or with diazomethane were discontinued in favor of an extensive investigation of the synthesis of azulene, developed by Ziegler and Hafner, from pyridine and cyclopentadiene. The initial studies provided a simplification of the experimental procedure leading to the

The items following each abstract are: the number of manuscript pages in the dissertation, its cost on microfilm, and the Library of Congress card number. Enlargements 5-1/2 x 8-1/2 inches, 4 cents per page. No postage is charged if check or money order accompanies order.

product of the enlargement of indane with diazomethane, trimethylenetropilidene. The utility of pure copper metal as a dehydrogenating agent for the latter compound was established.

The efforts of several other workers in this Department and the author permitted the contraction of Ziegler and Hafner's five-step procedure to three steps. Continuation of this work by the author culminated in a synthesis which was superior to those published at that time.

Several attempts to reduce 1-phenylazoazulene or 1,1'-azoazulene to the corresponding hydrazines in order to study the benzidine rearrangement on the azulene system were unsuccessful.

Treatment of 1-chloroazulene with benzenediazonium chloride and of 1-phenylazoazulene with N-chlorosuccinimide produced the same product, indicating that, as expected, further electrophilic substitution of 1-phenylazoazulene occurs at the 3-position. Thus, the product was 1-chloro-3-phenylazoazulene. A study of the chemistry of 1-phenylazoazulene lead to the syntheses also of 1-bromo-, 1-iodo-, 1-nitro-, 1-methyl-3-phenylazoazulene, and the presumed 1-acetyl-3-phenylazoazulene. Several attempts to prepare 1,3-diphenylazoazulene met with failure. An analysis of the visible spectra of these derivatives indicated that the phenylazo group effected a bathochromic shift of the visible absorption maximum of azulene. It was thought at the time that for 1- and 1,3-substituted azulenes a group more electron-attracting than hydrogen, which the phenylazo group was presumed to be, should effect a hypochromic shift. This group was therefore placed in the class of substituents, in which were included the halogens and N-acetyl oxime, the bathochromic visible spectral shifts of which had been previously termed anomalous.

Iodination studies on azulene led to a near quantitative yield of 1,3-diiodoazulene and very strong evidence for the formation of 1-iodoazulene.

The syntheses of bis-1-methyl-3,3'-azulylmethane and 1-bromo-3-acetylazulene, and the failure to produce bis-1,1'-azulylketone characterized preliminary studies of the synthesis of 1-substituted azulenes in which the substituent contained another azulene nucleus. 1-Bromo-3-acetylazulene and 1,3-diacetylazulene were found to be unstable to the conditions of the Kindler modification of the Willgerodt reaction.

Precise solution dipole moment measurements on azulene, 1-nitro-, and 1,3-dihalogenated azulenes provided ground state data which in conjunction with the calculated dipole moments of the lowest excited state of azulene permitted a possible rationalization of the visible spectral shifts for all known 1- and 1,3-disubstituted azulenes. A discussion of the possible relationship of the observed dipole moments to the electronegativity difference between the aromatic and substituent moieties and the polarizability of the Ar—X bond is included. 188 pages. $2.45.

NEGATIVELY SUBSTITUTED METHANES AS CARBENE PRECURSORS

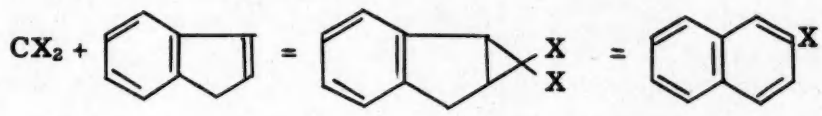
(L. C. Card No. Mic 58-1165)

Robert R. Twelves, Ph.D.
University of Minnesota, 1957

Major Adviser: W. E. Parham

The synthesis of 2-halonaphthalenes by the reaction of chloroform or bromoform with base in the presence of excess indene has been reported. A dihalocarbene (CX_2) has been proposed as the reactive intermediate in these reactions.

$$CHX_3 + B^- = CX_2 + HB + X^-$$

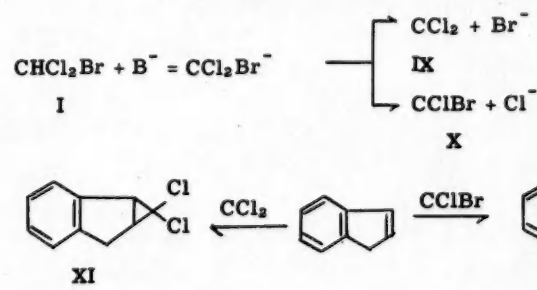


It was the purpose of this study to investigate other negatively substituted methanes in this reaction to: a) more adequately define the scope of this new synthesis of naphthalenes, and b) furnish additional information concerning the general chemistry of carbene precursors. The negatively substituted methanes I thru VIII investigated

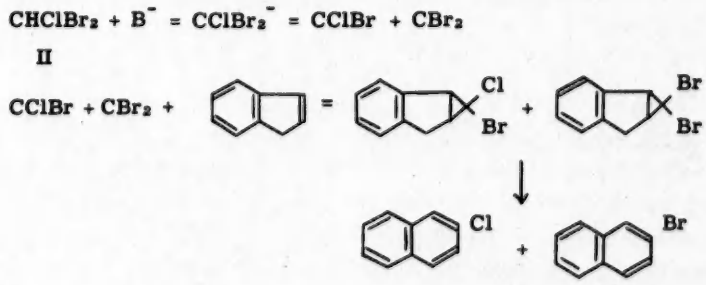
$CHCl_2Br$	$CHClBr_2$	$CHCl_2F$	$CHClF_2$	$CHCl_2COOC_2H_5$
I	II	III	IV	V

$CHCl_2COOC(CH_3)_3$	$C_6H_5COCH_2Br$	$\underline{p}$-$BrC_6H_4COCHBr_2$
VI	VII	VIII

Dichlorobromomethane (I) was found to react with indene and base to yield, preferentially, the cyclopropyl intermediate XI. It was observed that during carbene formation (IX and/or X) the ratio of bromide ion to chloride ion eliminated was approximately six to one.



Chlorodibromomethane (II) was found to react with indene and base, however the cyclopropyl intermediates were unstable and could not be isolated. Direct conversion of the crude product to naphthalenic material (steam-distillation) gave a high yield of a mixture of 2-chloro and 2-bromonaphthalene (c.a. 1:1). Thus it was concluded that one cannot predict the principal product obtained from the reaction of a mixed haloform, indene and base.

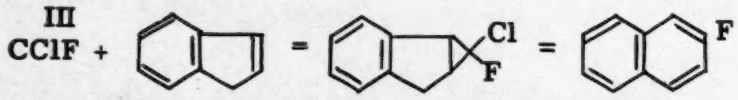


The items following each abstract are: the number of manuscript pages in the dissertation, its cost on microfilm, and the Library of Congress card number. Enlargements 5-1/2 x 8-1/2 inches, 4 cents per page. No postage is charged if check or money order accompanies order.

It was shown that 2-fluoronaphthalene was formed in the reaction of fluorodichloromethane (III), indene and base. The data obtained indicated: a) the formation, and b) the

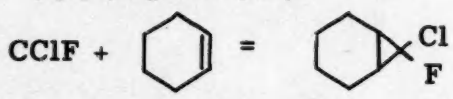
$$CHCl_2F + B^- = CClF + HB + Cl^-$$

III



the rearrangement of the cyclopropyl intermediate, was slower than analogous reactions when the halogens were chlorine or bromine.

The reaction of fluorodichloromethane (III), cyclohexene and base gave a product presumed to be 7-fluoro-7-chlorobicyclo-(4,1,0)heptane (XII)



XII

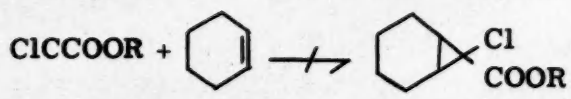
Difluorochloromethane (IV) reacted with indene and base to yield polymeric products.

It was shown that ethyl dichloroacetate (V) and tert-butyl dichloroacetate (VI) do not serve as precursors for carbalkoxycarbenes in the reaction under consideration.

$$CHCl_2COOR \not\longrightarrow ClCCOOR$$

The reaction of V and VI with indene gave, in each case, only a trace of acidic product; however the acids produced were different and were not identified.

The reaction of V and VI with cyclohexene and base led to a product, in each case, which was not the desired norcarane carboxylate. The mixture obtained from each ester



appeared to contain a common component. The composition, refractive index and infra-red spectrum of the product suggested that the common component may be 7,7-dichlorobicyclo(4,1,0)-heptane (XIII).



XIII

Phenacyl bromide and α,α dibromo-p-bromoacetophenone do not react with base to produce carbenes that will add to olefinic bonds. 83 pages. $2.00.

THE AUTOXIDATION OF HYDRAZOBENZENE

(Publication No. 24,966)

William John Zubyk, Ph.D.
University of Delaware, 1957

Supervisor: Harold Kwart

Summary

The homogeneous oxidation of hydrazobenzene and some hydrazobenzene derivatives by molecular oxygen have been studied. The effects of concentration, temperature, oxygen pressure, solvent, acid, bases, salts and various autoxidation catalysts have been studied in sufficient detail to permit a mechanistic interpretation and the formulation of a rate law for the autoxidation of hydrazobenzene.

The rate of oxidation was found to be directly dependent on the concentration of hydrazobenzene, oxygen, and base with acid exerting an inhibitory effect. Definite salt effects were observed. Cupric ions increased the rate of reaction and decreased the oxygen consumed by 50%. The preparation of N,N'-dideuterohydrazobenzene is described and the effect of deuterium substitution on the oxidation rate has been determined. Activation energies and changes in entropy have been calculated for the oxidation of hydrazobenzene in dimethylformamide, ethanol, and alcoholic sodium hydroxide. On the basis of the high negative entropies that were obtained, the transition intermediate is pictured as being a rigid, highly ordered, cyclic complex, with the rate determining step of the reaction being the decomposition of this complex to products. The effects of various substituents are discussed in terms of the proposed mechanisms for the reactions in dimetnylformamide and alcoholic sodium hydroxide.

313 pages. $4.05. Mic 58-4799

CHEMISTRY, PHARMACEUTICAL

A STUDY OF PRODUCTS OBTAINED BY THE IVANOV REACTION

(L. C. Card No. Mic 58-874)

Guenter Rolf Ackermann, Ph.D.
University of Michigan, 1957

The Ivanov reaction is one in which an Ivanov reagent – the alpha-halomagnesium derivative of a halomagnesium or metallic salt of an aryl- or vinyl-acetic acid – reacts in such a manner that the alpha-halomagnesium radical is replaced.

The use of the Ivanov reagent prepared from alpha-phenylpropionic acid, the interaction of the alpha-chloromagnesium derivative of chloromagnesium phenylacetate with substances which have not been employed hitherto in Ivanov reactions, and a study of some of the products obtained by Ivanov reactions, represent the substance of this investigation.

Twelve new beta-hydroxy acids were prepared by interaction of Ivanov reagents obtained from phenylacetic, alpha-phenylpropionic and alpha-phenylbutyric acids with the following aldehydes and ketones: formaldehyde, butyraldehyde, isobutyraldehyde, benzaldehyde, p-methoxybenzaldehyde, acetophenone, cyclobutanone, cyclopentanone, cyclohexanone and p-methylcyclohexanone.

Thirteen new beta-diethylaminoethyl esters were synthesized from beta-hydroxy acids by the use of beta-diethylaminoethyl chloride.

It was found that the alpha-chloromagnesium derivative of chloromagnesium phenylacetate reacted with benzyl bromide, allyl bromide and dimentyl sulfate to form alpha, beta-diphenylpropionic acid, 2-phenyl-4-pentenoic acid and alpha-phenylpropionic acid, respectively. Interaction

of the same Ivanov reagent with phenacyl chloride yielded alpha, beta-diphenyl-beta-hydroxy-gamma-chlorobutyric acid in two stereoisomeric forms. When phenacyl bromide was employed, the reaction products were alpha,beta-diphenyl-beta-hydroxy-gamma-butyrolactone, alpha,beta-diphenyl-gamma-crotonolactone and alpha,beta-diphenyl-beta-hydroxy-gamma-bromobutyric acid.

Each of the three acids, tropic, alpha-phenyl-alpha-(1-hydroxycyclohexyl)acetic and alpha-phenyl-beta-methyl-beta-hydroxybutyric acid, was treated with excess thionyl chloride and the reaction product was allowed to react with ammonia water. In the first instance, tropamide was obtained; in the second instance, a mixture of the lactone of the acid, alpha-phenyl-alpha-(1-cyclohexenyl)acetic acid and alpha-phenyl-alpha-cyclohexlideneacetic acid was produced; in the last case, the reaction product was alpha-phenyl-beta-methylcrotonamide.

It was found that the acid amide of tropic acid could be obtained in good yield by the use of a method in which the acid hydrazide hydrochloride was treated with chlorine to form the acid chloride, and the chloride was then treated with ammonia water. This method failed in the case of alpha-phenyl-alpha-(1-hydroxycyclohexyl)acetic acid since the hydrazide could not be obtained.

When an attempt was made to prepare the acid amide of alpha,beta-diphenyl-beta-hydroxypropionic acid by interaction of the methyl ester of the acid and ammonia water, the acid was recovered unchanged.

Both alpha-phenyltropic and alpha-methyltropic acid were acetylated, the acetyl derivatives were converted into the acid chlorides, the chlorides were treated with ammonia water, and in each case the acetyl derivative of the acid amide of the hydroxy acid was obtained. Attempts to remove the acetyl groups by the selective hydrolysis failed and only the original acids could be isolated.

Attempts to prepare an Ivanov reagent from alpha-phenyl-beta-methoxypropionic acid by the usual procedure, that is interaction of the acid with isopropylmagnesium chloride, were unsuccessful; in this instance the reaction product was alpha-phenylisocaproic acid.

96 pages. $2.00.

SYNTHESIS AND INVESTIGATION OF CERTAIN BIOLOGICAL ACTIVITIES OF SOME THIONOPHOSPHORIC ACID DERIVATIVES

(L. C. Card No. Mic 58-1255)

Mitchell Louis Borke, Ph.D.
University of Illinois, 1957
Chicago Professional Colleges

In this investigation two series of thionophosphoric acid derivatives having the general formula

$$(R_1O)_2\ \overset{\uparrow S}{P}\text{-}R_2$$

were prepared. In one of the series $R_1 = C_6H_5$, while in the second series $R_1 = p\text{-}C_6H_4CH_3$. In both series R_2 was an amine (aniline, ortho-, meta- or para-toluidine, ortho- or para-anisidine or piperidine) or chlorine. All compounds are white crystalline solids, insoluble in water but soluble in ethanol.

The substances were tested for AChase inhibition in vitro by the Hestrin colorimetric method. A commercial preparation of AChase (Winthrop Laboratories) in a suitable medium was used as the enzyme source. Of the fifteen compounds tested only diphenyl chlorothionophosphate and di-p-cresyl chlorothionophosphate exhibited some inhibition of AChase. Their molar concentrations for 50 percent inhibition of the enzyme (IN_{50}) were, respectively, $2.30 \cdot 10^{-4}$ and $2.60 \cdot 10^{-4}$. None of the amidothionophosphates were inhibitory toward AChase.

All of the synthesized compounds were tested for their ability to affect the growth of Micrococcus pyogenes var. aureus, Escherichia coli and Candida albicans, and to influence the germination of the seeds of oats and black mustard. Neither the amidothionophosphates nor the two chlorothionophosphates, which were inhibitory toward AChase affected the growth of the micro-organisms or the germination of the above-mentioned plant seeds.

The currently accepted theory states that an esteratic site of the enzyme attacks the electrophilic phosphorus atom of a phosphate-type inhibitor and results in the transfer of the phosphoryl group to the esteratic site of the enzyme yielding an inhibited enzyme. Similar behavior can be expected of a thionophosphoryl group. Thus the more electrophilic the phosphorus atom, the stronger the tendency to combine with the esteratic site of the enzyme and the more powerful should be its inhibitory action.

In the two chlorothionophosphates the electrophilic character of the phosphorus atom is determined by the inductive effect of the chlorine atom in the P-Cl bond and these two compounds are AChase inhibitors. In the amidothionophosphates, however, the proximity of the nitrogen atom with its two free electrons contributes to the resonance forms of the molecules and nullifies the electrophilic character of the phosphorus atoms. Consequently, these compounds do not exhibit in vitro any inhibitory properties toward AChase.

The inability of the amidothionophosphates (AChase non-inhibitors) as well as the two chlorothionophosphates to affect the growth of any of the micro-organisms tested could be explained either by their extreme insolubility in water or by the lack of a suitable enzyme system.

The negative results of the germination experiments could be attributed to the extreme insolubility of the synthesized compounds in water. Although hemicellulase and diastase are the enzymes present during the initial phase of the germination process, a number of enzymes known to be affected by phosphate-type inhibitors is synthesized during subsequent phases of it. Thus the inactivity of the two chlorothionophosphates cannot be attributed to the lack of a suitable substrate. 72 pages. $2.00.

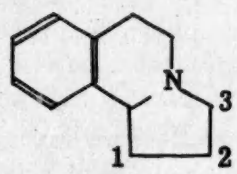
SYNTHESES OF ISOQUINOLINE DERIVATIVES USING 1-(LITHIO METHYL) ISOQUINOLINE

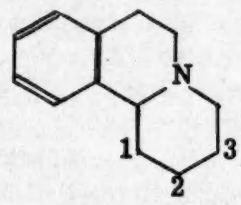
(L. C. Card No. Mic 58-1256)

Joseph Gerald Cannon, Ph.D.
University of Illinois, 1957
Chicago Professional Colleges

The alkaloid emetine has been used in the past as a prototype structure for the preparation of simpler, tricyclic compounds which might possess amebicidal activity. A

general method was sought for the synthesis of benzopyrrocolines and benzpyridocolines of types I and II, with a functional group in the 1, 2, or 3 position.





A new organometallic compound, 1-(lithio methyl) isoquinoline, was prepared in a quantitative yield from 1-methyl isoquinoline and n-butyl lithium, and was condensed with several organic moieties to produce some 1-alkyl substituted isoquinolines with more than one functional group on the side chain. One of these functional groups is available for closure of the third ring of the system, while the other functional groups would remain for further elaboration of the molecule. The 1-substituted isoquinolines are "open chain" analogs of portions of the emetine molecule, and might themselves be expected to exhibit some pharmacological activity. The compounds were characterized by formation of hydrochlorides, picrates, and methiodides.

A study of the formation and chemical properties of 1-(lithio methyl) isoquinoline was conducted, and an improvement of an existing method of preparation of 1-methyl isoquinoline was proposed.

Among the reagents whose behavior with 1-(lithio methyl) isoquinoline was investigated were: methyl iodide, isopropyl iodide, allyl bromide, methallyl bromide, benzophenone, butyrolactone, methylene malonic ester, (bromo methyl) malonic ester, fumaric ester, ethyl acetate, ethyl isobutyrate, ethyl acrylate, acrylamide, and benzalacetophenone.

The alkyl, isoquinaldyl ketones (resulting from condensation with esters) appeared to exist chiefly in the enolic form, due probably to chelate ring formation via a hydrogen bond. They formed copper (II) chelates readily, which served as convenient derivatives of the ketones. The probable stereochemistry of these copper (II) chelates was discussed.

Attempts to prepare and characterize 1-(lithio methyl) 3,4 dihydroisoquinoline resulted in essentially a quantitative recovery of the starting heterocycle, 1-methyl 3,4 dihydroisoquinoline. Possible reasons for the failure to prepare an organolithium compound in this case were presented.

An improvement of the Bischler-Napieralsky method was proposed for the preparation of 1-methyl 3,4 dihydroisoquinoline by a polyphosphoric acid cyclization of acetyl beta phenyl ethyl amine. Further experiments indicated that this method may be of general utility.

88 pages. $2.00.

THE SYNTHESIS OF HYDROXYQUINOLIZIDINES AND SOME OF THEIR ESTERS AS POTENTIAL THERAPEUTIC AGENTS

(L. C. Card No. Mic 58-1112)

Raymond Ernest Counsell, Ph.D.
University of Minnesota, 1957

A number of synthetic drugs have been prepared by modification of naturally-occurring compounds. In particular, cocaine and atropine have served as the prototypes for the development of a number of synthetic analogues with the hope of diminishing the undesirable side effects associated with the natural products. Because these natural products are esters of aminoalcohols, most of the early investigations tended toward variation of the acyl portion and simplification of the aminoalcohol portion of the molecules. As a result, a number of potent compounds were discovered such as Banthine and Procaine. Recently, however, the still existing need for valuable therapeutic agents has stimulated interest in esters of the more complex aminoalcohols which resemble the natural products more closely.

From the work that already had been carried out in the medicinal chemical field, it appeared that derivatives of the three isomeric 1, 2 and 3-hydroxyquinolizidines would provide a very interesting series for pharmacological screening. The diphenylacetate, xanthene-9-carboxylate, and phenylcyclohexylacetate hydrochlorides of the 1 and 3-hydroxyquinolizidines were prepared in the hope of discovering a potent antispasmodic-type of compound. Methobromides of the above compounds were prepared because quaternization has improved atropine-like activity in a number of instances. The benzoate and phenylcarbamate hydrochlorides of the three hydroxyquinolizidines were prepared as potential local anesthetic agents. It is interesting to note, that the benzoate ester of 2-hydroxyquinolizidine is a closed ring form of the local anesthetic, Metycaine. Since the quinolizidine ring structure is present in reserpine, the trimethoxybenzoate hydrochlorides of the three aminoalcohols were prepared. Screening of these compounds for reserpine-like activity would give some indication as to what portions of the reserpine molecule are essential for activity.

The synthesis of the three hydroxyquinolizidines and their precursors are described. The substituted acetic acid esters were conveniently prepared by treating the aminoalcohol with the desired acid chloride in the presence of triethylamine. The benzoate esters were prepared in essentially quantitative yields and in readily purifiable form by utilization of the ester interchange reaction. The phenylcarbamate esters were prepared in the usual manner by reacting the aminoalcohols with phenylisocyanate.

90 pages. $2.00.

The items following each abstract are: the number of manuscript pages in the dissertation, its cost on microfilm, and the Library of Congress card number. Enlargements 5-1/2 x 8-1/2 inches, 4 cents per page. No postage is charged if check or money order accompanies order.

A STUDY OF THE ASSAY AND STABILITY OF TABLET FORMULATIONS CONTAINING ASPIRIN, PHENACETIN AND SYMPATHOMIMETIC AMINES

(L. C. Card No. Mic 58-904)

William Robley Ebert, Ph.D.
University of Michigan, 1957

It is the purpose of this investigation to study the instability of tablets containing aspirin, phenacetin, and sympathomimetic amine salts, and to determine the external and internal factors causing deterioration. Particular attention was given to the causes and to the extent of these causes regarding the apparent loss of the amine salt.

To attain the primary objective, it was first necessary to devise new methods of assay since the procedures commonly used in control laboratories for these formulations are tedious, time-consuming, and are not suitable for an extensive study.

A method of determination for drugs with basic nitrogen groups, which involves precipitation of a tetraphenylboron complex of the sympathomimetic amine and subsequent titration of the hydrochloric acid liberated after reaction with excess mercuric chloride solution, was modified and found to give satisfactory results when used for the determination of amphetamine sulfate and methamphetamine hydrochloride. A procedure for the determination of these amine salts in tablets containing aspirin, phenacetin, and typical excipients was evolved. This method eliminates laborious extractions which are commonly employed for determinations of sympathomimetic amine salts in these combinations; and the method was found to be at least as precise as the extraction-titration procedure.

A three-component spectrophotometric method for the simultaneous determination of aspirin and phenacetin in the presence of salicylic acid was also devised. As compared to the double-titration method for aspirin and the gravimetric method for phenacetin, this method is much more rapid, and it was found to give satisfactory accuracy and precision.

In addition to the development of the above assay methods, three stability studies were carried out. In the first, aspirin, phenacetin, and amphetamine sulfate tablets containing different lubricants were prepared, stored at various temperature and moisture conditions, and assayed at regular intervals. The data obtained was used for an analysis of variance which showed the significance of such factors as lubricant, temperature, and moisture. In the second stability study, tablets containing sympathomimetic amine salts combined with 1) aspirin, 2) phenacetin, 3) aspirin plus phenacetin, all in combination with two lubricants were prepared and analyzed as in the first study. The effects of these different combinations upon stability were thus evaluated. A third stability study involved comparisons of salicylic acid and aspirin effects on loss of amphetamine sulfate. During this investigation it was shown that aspirin is capable of acetylating amphetamine.

As a result of these stability studies, some practical applications are presented which can be put to use for the preparation of more stable aspirin, phenacetin, and sympathomimetic amine salt preparations. 135 pages. $2.00.

ANALOGS OF DEMEROL AND AMIDONE

(L. C. Card No. Mic 58-939)

Kiyoshi Kitasaki, Ph.D.
University of Michigan, 1957

The purpose of this investigation was to synthesize analogs of Demerol and amidone. Various hydroxy and methoxy analogs of Demerol and esters of the seven-membered homolog of "cyclic amidone" were prepared.

The major part of this dissertation deals with the synthesis of analogs of Demerol (meperidine) which contain methoxy and hydroxy groups in the 3 and 4, in the 3 and 5, and in the 3, 4 and 5 positions of the benzene ring. The products obtained were ethyl 1-methyl-4-X-piperidine-4-carboxylates in which X represents 3,4-dimethoxyphenyl, 3,5-dimethoxyphenyl, 3,4,5-trimethoxyphenyl, 3,4-dihydroxyphenyl, 3,5-dihydroxyphenyl or 3,4,5-trihydroxyphenyl. The methoxy compounds were synthesized by the condensation of the required methoxyphenylacetonitriles and methyldi-(beta-chloroethyl)-amine in the presence of sodamide, hydrolysis of the 4-cyanopiperidines which were formed to the corresponding piperidine-4-carboxylic acids, and esterification of the acids with diazoethane. In order to obtain the 3,4-dihydroxy analog, 1-methyl-4-(3,4-dimethoxyphenyl)-4-cyanopiperidine was heated with 48% hydrobromic acid. The 1-methyl-4-(3,4-dihydroxyphenyl)piperidine-4-carboxylic acid hydrobromide which was produced was treated with ammonium hydroxide, and the free acid was then esterified with ethanol and hydrogen chloride. The other two hydroxy analogs were obtained in a similar manner.

Three analogs of ketobemidone, namely 1-methyl-4-(3,4-dimethoxyphenyl)- (I), 1-methyl-4-(3,5-dimethoxyphenyl)- (II) and 1-methyl-4-(3,5-dihydroxyphenyl)-4-propionyl-piperidine (III) were synthesized. 1-Methyl-4-(3,4-dimethoxyphenyl)-4-cyanopiperidine was treated with ethylmagnesium bromide and, after hydrolysis, compound I was obtained. Compound II was prepared by the same general process from 1-methyl-4-(3,5-dimethoxyphenyl)-4-cyanopiperidine. In order to obtain compound III, 1-methyl-4-(3,5-dimethoxyphenyl)-4-cyanopiperidine was allowed to react with ethylmagnesium bromide and the crude reaction product, the dimethoxy imino compound, was refluxed with 48% hydrobromic acid to hydrolyze the imino group and to demethylate the methoxy groups.

Two methoxy analogs of Nisentil (1,3-dimethyl-4-phenyl-4-propionoxypiperidine), namely 1-methyl-4-(3-methoxyphenyl)-(IV) and 1-methyl-4-(3,4,5-trimethoxyphenyl)-4-propionoxypiperidine (V) were obtained. 3-Methoxy-alpha-methylstyrene was condensed with formaldehyde and methylamine hydrochloride to form 1-methyl-4-(3-methoxyphenyl)-4-piperidinol. Interaction of the piperidinol with propionic anhydride yielded IV. Compound V was obtained in an analogous manner by the use of 3,4,5-trimethoxy-alpha-methylstyrene.

Three esters, the acetyl, propionyl and benzoyl derivatives, of 1-methyl-3-hydroxy-4,4-diphenylhexamethylenimine were synthesized. Diphenylacetonitrile was condensed with gamma-dimethylaminopropyl chloride, in the presence of sodamide, to yield gamma-dimethylaminopropyldiphenylacetonitrile. Treatment of the nitrile with methylmagnesium bromide and subsequent hydrolysis of the resulting 2-imino-3,3-diphenyl-6-dimethylaminohexane produced 3,3-diphenyl-6-dimethylamino-2-hexanone

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which, after distillation, was converted into the hydrobromide. When the salt was brominated, 1-bromo-3,3-diphenyl-6-dimethylamino-2-hexanone hydrobromide was obtained. Upon treatment of this substance with ammonia water, at room temperature, the liberated base underwent spontaneous cyclization to form 1-methyl-3-keto-4,4-diphenylhexamethylenimine methobromide. When this salt was heated, methyl bromide was liberated with the formation of 1-methyl-3-keto-4,4-diphenylhexamethylenimine. By the use of lithium aluminum hydride, the ketone was reduced to the secondary carbinol, 1-methyl-3-hydroxy-4,4-diphenylhexamethylenimine. The carbinol was treated with acetyl, propionyl and benzoyl chloride, respectively, with the formation of the basic ester hydrochlorides. After liberation of the bases from portions of the hydrochlorides, the former were converted into the methobromides.

125 pages. $2.00.

STABILITY OF RUBBER CLOSURES FOR INJECTIONS

(L. C. Card No. Mic 58-965)

George Milosovich, Jr., Ph.D.
University of Michigan, 1957

Incompatibility between rubber closures and injection solutions occurs frequently and is a major problem in the manufacture of parenterals. There is at present no reliable method for testing for this type of incompatibility and little knowledge of the nature of the reactions occurring. The chemical complexity of the rubber compositions and the variety of solutions with which they may be placed in contact would make a study of the chemical reactions of these incompatibilities excessively long and involved.

This investigation was undertaken to determine the nature and extensiveness of the physicochemical changes taking place in the rubber compositions, based on the hypothesis that physical changes must occur, allowing penetration of the rubber, before chemical change will take place.

Sorption by closures was measured from water, twenty solutions of inorganic compounds and twenty-eight solutions of organic compounds in order to detect penetration of closures by solvents or solutes. In most instances sorption was found to follow the previously reported equation $w = kt^n$, where w is weight sorbed (Gm. x 10^4), t is time (days) and k and n are constants. For comparison of effects one-year extrapolated values were used. Sorption by closures from solutions of inorganic compounds was generally found to be related to the decrease in vapor pressure of water due to the presence of the salts, following the equation $10^S = D^{-100} + 10^{132.7}$, where S is the amount sorbed (Gm. x 10^4) and D is the depression of vapor pressure (mm. of Hg). Potassium and sodium chlorides and phosphates were exceptions to this relationship, though their deviations were not great. Measurement of vapor pressure of solutions for this purpose was made by means of a specially designed isoteniscope.

Sorption by closures from solutions of organic compounds could not be related directly to vapor pressure. The majority of organic compounds increased sorption. It was demonstrated that many organic compounds are sorbed by the closures, and this was believed to explain the high sorption from their solutions.

Leaching as a result of special treatments of rubber closures could not be detected by sorption measurements. The methods designed to detect leaching were unsuccessful due to other changes occurring in the closures.

Sorption from sodium bisulfite solutions was found not to obey the general sorption law and this was shown to be due to a gradual breakdown of bisulfite, probably with the release of sulfur dioxide. Sorption from aqueous solutions of sulfur dioxide did follow the normal equation. Unusually high sorption from bisulfite or sulfur dioxide solutions was explained as a result of the rubber becoming more hydrophilic rather than due to the weight of sulfur dioxide sorbed. Sulfur dioxide gas was found to be sorbed by closures but to be desorbed rapidly when the closures were subsequently immersed in water. High sorption from acetic acid solutions was also explained as a high sorption of water and not due primarily to the weight of acetic acid sorbed.

A nephelometric method suitable for measuring haze formation due to rubber closures was developed, and several solutions as well as the six closure compositions were compared by this method. It was shown that bisulfite and acetic acid solutions prevent haze formation.

A comparison of the rubber compositions showed that in sorption effects and in haze formation there appeared to be a correlation between the degree of effect and the amount of filler present in the rubber. Statements were made to point out that compression recovery may be the significant physical property of the rubber composition.

Numerous practical applications of the results reported were discussed. 128 pages. $2.00.

QUATERNARY DERIVATIVES OF SUBSTITUTED DIETHYLENETRIAMINES

(L. C. Card No. Mic 58-1002)

Donald Lee Trepanier, Ph.D.
University of Michigan, 1957

During this investigation, simple, di-, tri-, tetra- and hexa-quaternary ammonium compounds were synthesized in order that they might be tested for neuromuscular and ganglionic blocking activity. In the past, the most extensively studied compounds have been those of the mono-, di- and tri-quaternary types.

Thirteen 4-substituted 1,1,7,7-tetramethyldiethylenetriamines were prepared in which the substituents were alkyl, acyl, nitroso or amino groups. The acyl derivatives were reduced with lithium aluminum hydride to the corresponding alkyl compounds. Twenty-five salts, hydrochlorides and methobromides, of the substituted diethylenetriamines were prepared.

N,N,N',N'-Tetra(beta-dimethylaminoethyl) derivatives of oxalamide, malonamide and succinamide were synthesized by interaction of 1,1,7,7-tetramethyldiethylenetriamine with either the required acid chloride or ethyl ester. These compounds were reduced with lithium aluminum hydride to N,N,N',N'-tetra(beta-dimethylaminoethyl)polymethylenediamines. Tetrahydrochlorides and tetramethobromides were prepared from the diamides. The polymethylenediamines were converted into hexahydrochlorides and tetra- and hexa-methobromides.

Interaction of 1,1,7,7-tetramethyldiethylenetriamine with chloroacetyl chloride yielded the 4-chloracetyl derivative which cyclized during the reaction to yield 1-(beta-dimethylaminoethyl)-2-keto-4-methylpiperazine methochloride hydrochloride. An analogous result was obtained by the use of 1,1,7,7-tetraethyldiethylenetriamine.

Pyrolysis of the monohydrochloride of 1,1,7,7-tetraethyldiethylenetriamine produced 1-ethylpiperazine.

Treatment of 1,1,7,7-tetramethyldiethylenetriamine with nitrous acid yielded the 4-nitroso compound which was reduced with lithium aluminum hydride to the 4-amino derivative. When this substance was allowed to react with ethyl dimethylaminoacetate, 1,1,7,7-tetramethyl-4-(dimethylaminoacetylamino) diethylenetriamine was obtained.

Attempts to prepare a hydrochloride or a methobromide from N,N,N',N'-tetra(beta-dimethylaminoethyl)methylenediamine, which was obtained by the action of formaldehyde on 1,1,7,7-tetramethyldiethylenetriamine, were unsuccessful. Hydrogen chloride cleaved the molecule with the formation of 1,1,7,7-tetramethyldiethylenetriamine trihydrochloride; the methylenediamine was converted by methyl bromide at room temperature, into 1,1,4,7,7-pentamethyldiethylenetriamine trimethobromide, and at an elevated temperature into 1,1,7,7-tetramethyldiethylenetriamine dimethobromide hydrobromide. 114 pages. $2.00.

CHEMISTRY, PHYSICAL

ABSOLUTE (d, α) REACTION CROSS SECTIONS AND EXCITATION FUNCTIONS

(L. C. Card No. Mic 58-1371)

Oswald Ulrich Anders, Ph.D.
University of Michigan, 1957

The purpose of this research was the determination of the cross sections of various (d, α) reactions induced by the 7.78 ± 0.05 Mev deuterons from the University of Michigan cyclotron. Special emphasis was given to reactions involving closed shell nuclei as target isotopes. Experimental techniques were refined to permit precision measurements of the cross section values.

The investigation involved the bombardment of thin targets of metallic zirconium, molybdenum and titanium as well as of zinc sulfide, subsequent chemical separation of the product nuclei, identification of the products by x-ray and γ-ray spectroscopy and determination of the absolute disintegration rates of β- and x-ray emitting isotopes.

The instruments constructed during this research included: a current integrator permitting measurement of the intensity of the cyclotron beam with 1% error; two 4π β-ray proportional counters, a four-inch diameter x-ray proportional counter filled with krypton at two atmospheres pressure and a beta thickness gauge for thin films.

Procedures were developed to calibrate the current integrator, to determine, with an accuracy of 1%, the evenness of target foils by a non-destructive method, to prepare cyclotron targets of materials sublimating below 1500° C by high vacuum evaporation, to purify various reaction products by using carrier-free chemical separations with decontamination factors of 10^5 and better. Methods were devised to determine the yield of the chemical separations with radioactive tracers, to identify various isotopes by their γ- and x-ray spectra, to count absolutely x-rays and β-rays with proportional counters as well as with a coincidence set-up, and to prepare thin films used for mounting the 4π counter samples.

The absolute cross sections, σ, were measured for the following reactions:

$Zr^{90}(d,\alpha)Y^{88}$ *	σ= 2.34 ± 0.28	millibarns at 7.56 ± 0.1 Mev
$Zr^{92}(d,\alpha)Y^{90}$ *	σ= 3.79 ± 0.26	millibarns at 7.56 ± 0.05 Mev
$Zr^{94}(d,\alpha)Y^{92}$ *	σ= 4.01 ± 0.28	millibarns at 7.56 ± 0.05 Mev
$Mo^{92}(d,\alpha)Nb^{90}$	σ= 2.95 ± 0.14	millibarns at 7.71 ± 0.05 Mev
$Mo^{97}(d,\alpha)Nb^{95}$ *	σ= 2.35 ± 0.14	millibarns at 7.71 ± 0.05 Mev
$Mo^{97}(d,\alpha)Nb^{95m}$	σ= 0.98 ± 0.09	millibarns at 7.71 ± 0.05 Mev
$Mo^{98}(d,\alpha)Nb^{96}$	σ= 2.53 ± 0.12	millibarns at 7.71 ± 0.05 Mev
$Ti^{46}(d,\alpha)Sc^{44}$	σ= 52.4 ± 2.6	millibarns at 7.71 ± 0.05 Mev
$Ti^{48}(d,\alpha)Sc^{46}$	σ= 28.5 ± 1.7	millibarns at 7.71 ± 0.05 Mev
$S^{34}(d,\alpha)P^{32}$ *	σ= 330.3± 23	millibarns at 7.73 ± 0.05 Mev

Excitation functions were determined for the reactions with asterisks. The decay scheme of Y^{88} was investigated and a metastable intermediary state discovered. Similar metastable states were found for the decay of Mn^{54} and Sn^{113}.

Absorption curves in beryllium were experimentally determined for x-rays emitted by Y^{88} and Mn^{54}.

270 pages. $3.50.

KINETICS OF THE DISSOLUTION OF CADMIUM IN NEUTRAL SALT SOLUTIONS

(Publication No. 24,947)

Charles J. Boone, Ph.D.
University of Delaware, 1957

Supervisor: Cecil C. Lynch

The initial rate of the dissolution of cadmium in various concentrations of carbon dioxide free air saturated neutral salt solutions at 25°C. was studied polarographically. The salts employed were potassium chloride, sodium chloride, barium chloride, potassium bromide, sodium bromide, potassium iodide, sodium perchlorate, and barium perchlorate. The experiments were run in such a manner that the only variable effecting the rate of dissolution of the cadmium was the concentration of the salt solutions.

The order of reaction due to the salt was calculated at 25°C. for the initial rate of dissolution of cadmium for each of the above salts. The nature of the anion was shown to have a much greater effect on the initial rate of dissolution of cadmium than does the nature of the cation. The perchlorate ion acts as an inhibitor to the initial dissolution rate of cadmium. The iodide salts have a maximum in the dissolution rate versus concentration curve. The results obtained for the perchlorate and the iodide ions are explained on the basis of the film forming properties of these anions. 72 pages. $2.00. Mic 58-4800

A HIGH PRECISION ADSORPTION APPARATUS

(L. C. Card No. Mic 58-1077)

George Constabaris, Ph.D.
University of Washington, 1957

Recently in these laboratories a gas-surface interaction theory, analagous in form to that for imperfect gases, has been successfully applied to experimental adsorption data obtained in a temperature region above the critical condensation temperature of the adsorbate. The advantages of carrying out the investigations in this region, and the success of the theory, showed that an increase in the accuracy of the methods used would be of great value in the study of the primary interactions that lead to adsorption because the experimental range could be extended into that in which higher order interactions can be observed, and adsorbents with homogeneous surfaces could be used despite the low specific areas that are displayed by these. An apparatus has been developed and calibrated that achieves the aim of increasing the accuracy of the measurements by an order of magnitude. In this apparatus the temperature of the sample bulb is controlled to within .001° in a cryostat designed after the fashion of a low temperature adiabatic calorimeter, and the precise methods used to measure the pressure in gas thermometry have been used. A gas transfer system has been developed which has an accuracy compatible with the rest of the components. Extensive tests have shown that the system can be used to measure volumes in the desired range of about 50 mls. to two parts in ten thousand.

A brief experimental examination of the interactions in a highly graphitized carbon black-argon system has been made with the apparatus. From these experiments adsorption isotherms have been obtained in a range not previously available. The isosteric heats so obtained are in agreement with values obtained elsewhere.

The application of the data to the simple model used in the interaction theory has also been satisfactory: the difference between the energies of interaction and isosteric heats obtained in this work and in the previous work is due to the high degree of homogeneity of the carbon black used here. 190 pages. $2.50.

THE INTERMOLECULAR POTENTIALS OF ARGON METHANE AND ETHANE

(L. C. Card No. Mic 58-901)

Andrew Gabriel De Rocco, Ph.D.
University of Michigan, 1957

The Chapman-Enskog theory gives the transport properties of a dilute non-polar gas in terms of a set of integrals which involve the intermolecular force law. Since direct calculation of the force law is impossible at the present time, the usual procedure has been to compare experimentally derived collision integrals with those computed for an assumed force law having several adjustable parameters. The Exp-Six potential differs from the usual Lennard-Jones potential in two significant ways: 1) it represents the short range repulsive forces by an exponential term rather than the term in r^{-12} employed by Lennard Jones, 2) it contains an additional parameter, α, related to the steepness of the repulsive part of the potential.

The objectives of this research were to measure the viscosities of argon, methane and ethane from ca. 200-500° K, and from these data to derive the potential parameters for the three gases from the temperature variation of the viscosity.

The viscosities of argon, methane, and ethane have been determined from 210°K to 473°K using a capillary viscometer. The viscometer was calibrated using oxygen, and a secondary calibration with helium confirmed the reliability of the primary calibration. The estimated accuracy of the method was 0.5 per cent.

The results for argon were in substantial agreement with previous investigations, while those for methane and ethane were a few per cent higher than previously reported values.

The potential parameters for an Exp-Six potential were determined from the viscosity data. For argon and methane the agreement between calculated and experimental values for the transport coefficients and second virial coefficients was very good. For ethane, however, a single set of parameters was unable to fit both the transport and equilibrium properties. It was concluded that the Enskog-Chapman theory failed for the slightly non-spherical ethane molecule. It was suggested that proper modification of the Enskog-Chapman theory would probably resolve the non-spherical problem and permit a detailed comparison of the Exp-Six and Lennard-Jones potentials.

The potential parameters determined for the three gases are summarized below:

1) Argon $r_m = 3.867\text{Å}$; $(\epsilon/k) = 123.0$; $\alpha = 14$
2) Methane $r_m = 4.209\text{Å}$; $(\epsilon/k) = 152.4$; $\alpha = 14$
3) Ethane $r_m = 4.905\text{Å}$; $(\epsilon/k) = 229.1$; $\alpha = 16$ (viscosity)
$r_m = 5.226\text{Å}$; $(\epsilon/k) = 249.5$; $\alpha = 16$ (2nd virial)

The results reported above for argon and methane are in good agreement with previously reported values, while for ethane no previous results have been reported.
104 pages. $2.00.

THE VAPOR PRESSURE OF ALUMINUM CHLORIDE, ALUMINUM BROMIDE AND THE MIXED HALIDE PHASE $Al_2Br_2Cl_4$

(L. C. Card No. Mic 58-1079)

Thomas Gregory Dunne, Ph.D.
University of Washington, 1957

The vapor pressures of aluminum chloride, aluminum bromide, and the mixed halide phase $Al_2Br_2Cl_4$ (produced by the addition of HCl to aluminum bromide) were measured in the vicinity of room temperature using the Knudsen effusion method.

The equation for the best visual straight line for a log P vs 1/T plot of the aluminum chloride data is $\log P_{mm} = \frac{-6560}{T} + 17.84$. The heat of sublimation is found to be 29.9 1 kcal. per mole.

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The equation for aluminum bromide is log Pmm = $\frac{-4320}{T}$ + 12.23 and the heat of sublimation is equal to 19.7 ± 1 kcal. per mole.

Since no dependence of the vapor pressure on cell geometry could be found for aluminum chloride or aluminum bromide, the condensation coefficient was assumed to be greater than 1×10^{-2} for aluminum chloride and greater than 2×10^{-2} for aluminum bromide.

Mixed halide samples were found to give high pressures which gradually fell off to lower values. Over a considerable time samples were found to give constant values in the vicinity of a line expressed by the equation log Pmm = $\frac{-6060}{T}$ + 17.68. This line is assumed to represent the variation of the vapor pressure of $Al_2Br_2Cl_4$ with temperature. The heat of sublimation is found to be 27.6 ± 2 kcal. per mole of $Al_2Br_2Cl_4$. The degree of gas phase disproportionation of the mixed halide to Al_2Cl_6 and Al_2Br_6 is estimated to be .14%, indicating that gaseous $Al_2Br_2Cl_4$ is slightly more stable than the solid.

Transpiration measurements were made on aluminum bromide in the vicinity of room temperature, but vapor pressures could not be obtained, since no range of flow rates was found in which the partial pressure of aluminum bromide was independent of flow rate.

$Al_2Br_2Cl_4$ gave a reproducible infra-red spectra, but this yielded no conclusive information on the structure.

87 pages. $2.00.

THE KINETICS OF THE THERMAL DECOMPOSITION OF PENTACHLOROETHANE

(L. C. Card No. Mic 58-1415)

Thomas Houser, Ph.D.
University of Michigan, 1957

The pyrolysis of pentachloroethane has been studied in a flow system over the temperature range 407 to 438°C. Helium and nitrogen were used as carrier gases; contact times ranged from 6 to 35 seconds. A cyclone "stirred flow" reactor and a packed, tubular, flow reactor were used.

The major products were C_2Cl_4 and HCl; very small amounts of C_2Cl_3H and Cl_2 were also formed. The organic products were measured by infrared techniques; HCl and Cl_2 were titrated.

The reaction is autocatalytic, is catalyzed by Cl_2, and inhibited by propylene and chloroform; it is therefore believed to be of a radical chain nature. The rate of pyrolysis of pentachloroethane-d (91%D) was approximately 40% lower than that of the hydrogen compound.

The data obtained using the cyclone reactor with a helium carrier may be represented by the following rate expression:

$$dx/dt = k(a-x)(1 + bx)^{1/2},$$

where x is the concentration of HCl in the exit stream, a is the initial concentration of C_2Cl_5H, and t is the contact time. The rate constant k and the acceleration constant b are given by the following equations:

$k\ (sec.^{-1}) = 10^{12.97} \exp[-48{,}000/RT]$ and
$b\ (lit./mole) = 10^{-2.1} \exp[+23{,}000/RT]$.

The proposed reaction mechanism is:

(1) $C_2Cl_5H \rightarrow C_2Cl_4H\cdot + Cl\cdot$
(2) $Cl\cdot + C_2Cl_5H \rightarrow HCl + C_2Cl_5\cdot$
(3) $C_2Cl_5\cdot \rightarrow C_2Cl_4 + Cl\cdot$
(4) $C_2Cl_4H\cdot \rightarrow C_2Cl_3H + Cl\cdot$
(5) $C_2Cl_5\cdot + Cl\cdot \rightarrow C_2Cl_4 + Cl_2$
(6) $Cl_2 + C_2Cl_5H \rightarrow C_2Cl_5\cdot + Cl\cdot + HCl$

Application of the steady-state treatment to this mechanism results in the expression:

$$-d[C_2Cl_5H]/dt = (k_1k_2k_3/k_5)^{1/2}[C_2Cl_5H]\ \langle 1 + (k_6/k_1)[Cl_2]\rangle^{1/2}$$

Comparison with the observed rate equation shows that $k = (k_1k_2k_3/k_5)^{1/2}$ and $b = k_6/k_1z$, where $z = [HCl]/[Cl_2]$. Calculated activation energies using estimated values for the individual steps are 49.5 and 24 kcal./mole for k and b respectively.

The integrated form of the rate equation was used in treating the data in the tubular reactor:

$$kt = \frac{2.303}{(1+ab)^{1/2}} \log_{10} \frac{[(1+ab)^{1/2} + (1+bx)^{1/2}}{[(1+ab)^{1/2} - (1+bx)^{1/2}} \cdot \frac{(1+ab)^{1/2} - 1]}{(1+ab)^{1/2} + 1]}$$

The values of k obtained in the two reactors differed by approximately 25%.

The rate was slightly influenced by the carrier gas; results with nitrogen were somewhat greater than with helium. This effect is qualitatively explained in terms of relative efficiencies of energy transfer. 118 pages. $2.00.

THE IODINE COMPLEXES OF SOME SATURATED CYCLIC ETHERS

(L. C. Card No. Mic 58-1416)

Sister Mary Brandon Hudson O. P., Ph.D.
University of Michigan, 1957

A spectroscopic investigation of the iodine complexes of propylene oxide, trimethylene oxide, tetrahydrofuran, 2-methyltetrahydrofuran, tetrahydropyran, and ethyl ether was undertaken to obtain a quantitative measure of the relative electron-donor ability of the ethers in order to determine how this ability varied with ring size.

Investigation of the spectra over a temperature range was made using a Beckman spectrophotometer, Model DU. Analysis of the temperature dependence of the equilibrium constants permitted the evaluation of the enthalpies ($-\Delta H^\circ$ ± 0.2 kcal/mole), free energies ($-\Delta F^\circ$ ± .02 kcal/mole), and entropies ($-\Delta S^\circ$ ± 0.8 e.u.) of formation of the complexes. The results are as follows:

trimethylene oxide ($-\Delta H^\circ$ = 6.4, $-\Delta F^\circ_{25^\circ}$ = 1.93. $-\Delta S^\circ$ = 15.0)
2-methyltetrahydrofuran ($-\Delta H^\circ$ = 6.2, $-\Delta F^\circ_{25^\circ}$ = 1.84, $-\Delta S^\circ$ = 14.6)
tetrahydrofuran ($-\Delta H^\circ$ = 5.3, $-\Delta F^\circ_{25^\circ}$ = 1.70, $-\Delta S^\circ$ = 11.6)
tetrahydropyran ($-\Delta H^\circ$ = 4.9, $-\Delta F^\circ_{25^\circ}$ = 1.66, $-\Delta S^\circ$ = 10.7)
propylene oxide ($-\Delta H^\circ$ = 3.8, $-\Delta F^\circ_{25^\circ}$ = 1.10, $-\Delta S^\circ$ = 9.0)
ethyl ether ($-\Delta H^\circ$ = 4.2, $-\Delta F^\circ_{25^\circ}$ = 1.12, $-\Delta S^\circ$ = 10.3)

These thermodynamic data indicate that the variation of basicity with ring size of the ether is in the order 4-> 5-> 6-> 3-membered ring.

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The position in the visible region of the absorption maximum at 520 mμ. for iodine in n-heptane is shifted to 450-462 mμ. when an ether is added to the iodine, the extent of the shift (from the visible) toward the ultraviolet region being related to the basicity of the ether. These spectral shifts are consistent with the thermodynamic results; namely, 4- > 5- > 6- > 3-membered ring.

Use was made of the Mulliken charge-transfer theory to interpret the spectral data of the complexes in the ultraviolet region. Assuming the theory to be valid, and that several approximations are permitted, an estimate of the polarity of the iodine-ether complex can be made. The polarity of the complexes, which in turn may be related to the basicities of the ethers, also gives a basicity order of 4- > 5- > 6- > 3-membered ring.

The results of this study on the variation in basicity with ring size for the cyclic ethers are in agreement with data which have appeared in the literature and which were obtained by very different methods. To explain the observed variation, it seems reasonable to assume that the change in angular requirements in forming different-sized rings must result in a redistribution of the electrons in the molecule. This would, of course, affect the availability of the lone pair electrons on the oxygen atom in different-sized rings and hence affect the properties of the molecule. An alternate explanation based upon strain factors, proposed by Brown and Gerstein to explain observations on other ring systems, is shown to be inapplicable.

An attempt was made to extend this study to ring compounds which contain an oxygen atom outside the ring, as in the cyclic ketones and lactones. Side reactions of iodine with cyclohexanone and with γ-butyrolacetone made the results uncertain for these compounds. However, suitable data were obtained for the iodine complexes of cyclopentanone and cycloheptanone, the latter being the more basic. This also agrees with literature reports that the compound becomes more basic with increasing ring size when the oxygen atom is outside the ring. 139 pages. $2.00.

LOW TEMPERATURE HEAT CAPACITIES OF LAYER AND CHAIN TYPE CRYSTALLINE STRUCTURES

(L. C. Card No. Mic 58-950)

John Joseph McBride, Ph.D.
University of Michigan, 1956

Measurements of heat capacity by an adiabatic technique have been made from 5° to about 350°K on lead iodide, arsenic triiodide, molybdenum disulfide, zinc chloride, and silver cyanide. Experimental and smoothed heat capacity data are presented. The first four substances have "sandwich-type" layer crystal structures while the fifth, silver cyanide, has a chain-type structure.

The main purpose of these measurements was to obtain experimental data to aid in evaluation of current theories dealing with the lattice vibrational heat capacities of layer and chain type crystalline structures. While the major portion of the work was experimental, an attempt was also made to correlate the results with the predictions of the above mentioned theories, especially the predicted temperature dependence of the low temperature heat capacities of layer structures.

It was found that for none of the "sandwich-type" layer structures investigated was the low temperature heat capacity precisely represented over any finite temperature range by a simple expression of the form $C_p \alpha T^2$. Short regions were found where this expression was a crude approximation to the experimental data, but these regions are not deemed theoretically significant. It is further suggested that it seems likely that no substance with the "sandwich-type" layer crystal structure will exhibit a strict T^2 dependence of its low temperature heat capacity, and that the total experimental evidence (literature, unpublished data, plus this research) indicates that such behavior is not a generally occurring property of all layer structures. The results of this research are in contrast to theoretical predictions, with the exception of those of Newell and Rothstein.

Heat capacity measurements on the chain structure, silver cyanide, did not reveal any significant region where $C_p \alpha T$. This is in contrast to theoretical prediction; however generalizations were not attempted since only one example ofthis type of structure was investigated.

The analysis of heat capacity data by the calculation of characteristic temperatures, and the usefulness of the Tarasov two-parameter equations for representing heat capacity data of anisotropic solids are discussed briefly.

Anomalous regions were found in the heat capacity of silver cyanide from 250° to 285°K, and in the heat capacity of arsenic triiodide at 161°K, and from 225° to 290° K. The anomaly at 161° K for arsenic triiodide is attributed to an impurity effect. Possible causes for the other anomalous regions are discussed.

For chemical thermodynamic purposes, the values of the molal enthalpy, entropy, and free energy functions have been calculated and are presented at rounded temperatures for the substances investigated. The molal values for the smoothed heat capacity, entropy, and enthalpy functions at 298.16°K, together with their standard deviations are:

	C_p cal./deg.	$(H^\circ - H^\circ_0)$ cal.	S° cal./deg.
PbI_2	18.49 ± 0.15%	4666 ± 0.15%	41.79 ± 0.15%
AgCN	15.95 ± 0.15%	3206 ± 0.15%	25.62 ± 0.15%
MoS_2	15.19 ± 0.15%	2528 ± 0.15%	14.96 ± 0.15%
AsI_3	25.28 ± 0.3%	5964 ± 0.3%	50.92 ± 0.3%
$ZnCl_2$	17.05 ± 0.15%	3598 ± 0.15%	26.64 ± 0.15%

131 pages. $2.00.

A NEW ADIABATIC HIGH TEMPERATURE CALORIMETER AND THE HEAT CAPACITY OF IRON(II) BROMIDE

(L. C. Card No. Mic 58-1090)

Harry Edward O'Neal, Ph.D.
University of Washington, 1957

A high temperature adiabatic calorimeter has been constructed which can be used for the measurement of the specific heats of corrosive, reactive, and easily oxidizable materials in a temperature range from 50°C to 450°C. The

performance of the calorimeter has been tested using α-Al_2O_3 with a maximum point deviation of 2.0% and an average point deviation of 0.5% compared to the most recent data given in the literature for that substance.

The heat capacity of two crystal forms of Iron(II) bromide have been measured from 50°C to 450°C. Four separate sample preparations were examined, two of random-packed material and two of ordered-packed material, with an average deviation from the smoothed curve of 0.65% from 50°C to 360°C. Equations for the heat capacity, relative enthalpy, and relative entropy in this temperature range are:

$$C_p = 17.59 + 5.32 \cdot 10^{-3}T$$

$$H_T - H_{298.16} = 17.59\ T + 2.66 \cdot 10^{-3}T^2$$

$$S_T - S_{298.16} = 40.51 \log T + 5.32 \cdot 10^{-3}T$$

An anomaly in the heat capacity behavior was observed, in all samples, beginning around 360°C and extending over a 25°C temperature range. The cause of this behavior has not been established. An x-ray examination of quenched samples failed to provide conclusive evidence of any relationship between the transition and the two crystalline forms forms of iron(II) bromide.

The possibility that the anomaly results from magnetic changes or impurities in the sample has been considered and shown to be highly improbable.

A differential cooling study of the anomaly has demonstrated a striking dependence of the transition temperature on the presence of small amounts of water.

Several improvements in design of the calorimeter have been suggested. 76 pages. $2.00.

A KINETIC STUDY OF THE DISSOLUTION OF UO_2 IN CARBONATE SOLUTIONS

(Publication No. 21,685)

Ray L. Pearson, Ph.D.
University of Utah, 1957

Chairman: Dr. Milton E. Wadsworth

The leaching of UO_2 in carbonate solutions was investigated and the rate of leaching measured by determining the concentration of $UO_2(CO_3)_3^{=}$ ion in solution at various times and under known conditions. The rate was determined as a function of time, agitation of the solution, carbonate concentration, and overpressure of oxygen. A mechanism was postulated that satisfied the experimental observations.

The leaching of uranium was found to be linear over the range of time under all the conditions investigated, and the rate was observed to be directly proportional to the square root of the partial pressure of oxygen. The rate at various concentrations of ions was determined to be a function of the concentration of undissociated H_2CO_3. Both atomic oxygen and H_2CO_3 were determined to be adsorbed on the reaction sites and the rate determining step was the rearrangement of the atomic oxygen on one of these sites, or the diffusion of atomic oxygen over the surface sites.

Calculations of the energy of activation for the overall process using the Arrhenius equation was found to be 6.73 kcal/mole. With this value it was determined that only one in every 62,800 surface sites was active.

51 pages. $2.00. Mic 58-4801

AN ELECTRON IMPACT STUDY OF CARBON MONOXIDE

(Publication No. 25,416)

Sam Silverman, Ph.D.
The Ohio State University, 1952

The objectives of the investigation were twofold: the construction and testing of a revised version of the electron spectrometer described by Francis[1] and Jones,[2] and a comprehensive study of the absolute collision cross sections and energy spectra of carbon monoxide at several voltages and scattering angles.

The new electron spectrometer differs from the old in the following respects: A parallel plate electrostatic velocity analyzer for the scattered current similar to that described by Yarnold and Bolton[3] is used; an electron multiplier based on a design by Allen[4] is used in conjunction with a preamplifier, linear amplifier, and multiscaler for the measurement of the scattered current; and several changes in the electron gun control and measurement circuits have been made to obtain greater stability and accuracy. In terms of performance, these changes have led to increased resolution and a higher sensitivity in the measurement of the scattered current. Work on the construction and development of the apparatus was carried out with M. E. Krasnow.

Energy spectra of carbon monoxide have been obtained for incident electron energies ranging from 115 volts to 600 volts, and, at 500 volts, for scattering angles from zero to 9.9 degrees. The excitation potentials determined from peaks in these spectra occurred at 8.35 volts, 10.78 volts, 11.41 volts, 13.24 volts, 13.55 volts, 15.24 volts, 16.46 volts, and 17.09 volts. In addition, several probable excitations in the 12.5 – 15.0 volt range could be seen on the graphs as shoulders. These results are in good agreement with those of Rudberg,[5] when account is taken of the increased resolving power of the new spectrometer, except for the 21.90 volt loss reported by Rudberg, which was not found in this investigation.

A comparison of peak currents at several scattering angles and 500 volt electrons shows that the angular variation of the scattered currents for the 8.35 volt and 10.78 volt excitations are about the same, both being radically different from that for the 11.41 volt excitation.

The angular dependence of scattered current for the 8.35 volt excitation was studied at 420, 500, and 600 volts incident electron energies for scattering angles between 4 and 15 degrees. Absolute collision cross sections and differential oscillator strengths (oscillator strengths per unit energy range) were calculated from these data. A plot of cross sections as a function of the change in momentum on impact showed that the Born approximation was satisfactory down to at least 420 volts, since the experimental points for the three voltages fell on the same curve. The differential oscillator strengths, determined from the zero angle spectrum, were integrated for the entire transition to give an optical oscillator strength of 0.24.

The angular dependence of scattered current for the 11.41 volt excitation was determined at 600 volts incident electron energy for scattering angles between 4 and 9 degrees. Absolute collision cross sections and differential oscillator strengths were calculated from these data. The cross sections were found to fall off much more rapidly with angle than those for the 8.35 volt excitation. The differential oscillator strengths, plotted as a function of the square of the change in momentum on impact, ΔP^2, were extrapolated to zero ΔP^2 to give a value of 0.43. This value must be considered as approximate because of the large curvature at small values of ΔP^2. A calculation of the differential oscillator strength at zero ΔP^2 using the zero angle energy spectrum gave a value of 0.67.

The collision cross sections for energy losses from 7.0 – 32.0 volts were calculated from the energy spectra at 500 volts and tabulated as a function of scattering angle.

Elastic cross sections for electrons with 600 volts incident energy were determined for scattering angles from ten to ninety degrees. Theoretical elastic cross sections were calculated using scattering factors calculated by Berman[6] from Slater type wave functions. The discrepancy between the theoretical and elastic cross sections was of the order of magnitude of 25 per cent except at large values of ΔP where good agreement was found.

Several proposed models for the structure of carbon monoxide were discussed. It was concluded that none of these gives a satisfactory explanation of the experimental facts. A comparison of the data for the 8.35 volt excitation of carbon monoxide was made with that for the analogous transition in nitrogen, which has been observed by Krasnow.[7] In nitrogen, this transition is optically forbidden and hence the oscillator strength is zero. Thus if the two molecules are similar, the oscillator strength for the 8.35 volt excitation of carbon monoxide should also be small. Experimentally, however, the oscillator strength was found to be 0.24, comparable to that of an intense transition. It was therefore concluded that there is no obvious similarity between carbon monoxide and nitrogen.

In addition to the primary investigations on carbon monoxide, energy spectra for acetone and methyl ethyl ketone were obtained at 500 and 220 volts for zero scattering angle and for a scattering angle of about seven degrees. Both ketones have excitations at about 4.2 and 6.4 volts and a large number of intense unresolved excitations above 7.5 volts. A remarkable change in the appearance of the spectra with scattering angle was evident. In particular, the scattered currents for the continuum remain very high at wide scattering angles. In carbon monoxide, though the relative intensity of the continuum increases, the spectra remain recognizable as those of carbon monoxide as the scattering angle is increased. In acetone, however, the change is so great that the wide angle and zero angle spectra appear to be those of two different compounds.

Summary

1. A new electron spectrometer has been built and tested.

2. Energy spectra of carbon monoxide have been obtained for incident electron energies from 115 to 600 volts, and, at 500 volts, for scattering angles from zero to 9.9 degrees.

3. Collision cross sections and differential oscillator strengths for the 8.35 volt excitation of carbon monoxide have been determined for incident electron energies of 420, 500, and 600 volts and scattering angles between 4 and 15 degrees. The optical oscillator strength for this transition was found to be 0.24.

4. Collision cross sections and differential oscillator strengths for the 11.41 volts excitation of carbon monoxide have been determined for an incident electron energy of 600 volts, and scattering angles between 4 and 9 degrees.

5. Collision cross sections for energy losses between 7 and 32 volts in carbon monoxide as a function of scattering angle have been calculated from energy spectra obtained with electrons of 500 volts incident energy.

6. Experimental and theoretical elastic cross sections for carbon monoxide have been obtained for scattering angles between 10 and 90 degrees with electrons of 600 volts incident energy.

7. Several structural models for carbon monoxide have been critically reviewed in the light of the data obtained in this investigation. A comparison with electron impact data for nitrogen has been made.

8. Several energy spectra for acetone and methyl ethyl ketone have been obtained.

122 pages. $2.00. Mic 58-4802

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2. Jones, Ernest A. "Inelastic Scattering of Electrons by Molecular Hydrogen," Abstracts of Doctoral Dissertations. Columbus, Ohio: The Ohio State University Press, 1947-48, 56 pp. 293-300.

3. Yarnold, G. D., and Bolton, H. C., "The Electrostatic Analysis of Ionic Beams," J. Sci. Instr. and Phys. in Ind., 26 (Feb., 1949), pp. 38-40.

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7. Krasnow, Marvin E. "Electron Impact Studies of Nitrogen, Ethylene and Benzene," Doctoral dissertation, The Ohio State University, 1952.

Abstract published by special arrangement with The Ohio State University.

The items following each abstract are: the number of manuscript pages in the dissertation, its cost on microfilm, and the Library of Congress card number. Enlargements 5-1/2 x 8-1/2 inches, 4 cents per page. No postage is charged if check or money order accompanies order.

AN INVESTIGATION OF TECHNIQUES FOR THE SEPARATION OF HYDROGEN AND DEUTERIUM: PART I: ZONE REFINING OF MIXTURES OF ORDINARY AND HEAVY WATER; PART II: THE REACTION OF IRON WITH MIXTURES OF ORDINARY AND HEAVY WATER; PART III: GAS CHROMATOGRAPHY WITH HYDROGEN AND DEUTERIUM SAMPLES

(L. C. Card No. Mic 58-1327)

Carl Owens Thomas, Ph.D.
University of Tennessee, 1957

Major Professor: Hilton A. Smith

Part I

A theoretical analysis was developed for the separation of the isotopic forms of water by a zone-refining process. The separation was confirmed experimentally but was found to be much less than that predicted by the theory. The quantitative discrepancy was attributed to the very slow rate of diffusion in the water.

Part II

The production of hydrogen by the reaction of iron with various salt solutions was studied. It was possible to increase the rate of hydrogen production by plating various metals onto portions of the iron surface. These metals served as cathodic surfaces for the evolution of hydrogen. The increase in the reaction rate appeared to be limited by polarization of the cathode.

The reaction rate per unit area of the iron samples was approximately the same for uncoated iron powder and for uncoated bulk iron. However, the geometrical arrangements which are possible with bulk iron were capable of eliminating the quenching effect observed with iron powder.

The introduction of various cathodic surfaces to increase the reaction rate did not appear to affect significantly the separation factor.

Some electrolysis experiments were performed with steel electrodes in order to investigate the effects upon the separation factor of various methods of stirring the solution. Vigorous agitation of the solution with an ultrasonic generator increased the separation factor by approximately 15 per cent.

The separation factors calculated for the reaction between iron and water and for the electrolysis of water are consistent with other values reported in the literature.

Part III

The separation of hydrogen and deuterium by gas chromatography was investigated using a column in which the fixed phase was palladium metal supported on granular flint quartz. Displacement, frontal-analysis, and elution techniques were used. Hydrogen was the displacing agent in the displacement experiments.

The equilibrium separation factor, α, was determined from data obtained by the frontal-analysis and by the elution techniques. The temperature dependence of the separation factor was found to be represented by the expression,

$$\log \alpha = 222/T - 0.51$$

where T is the absolute temperature.

Partial resolution of the components of a hydrogen-deuterium mixture was obtained by elution chromatography, using argon as the carrier and as the reference gas. The separation was less than that which might be expected from a comparison of the elution peaks for pure hydrogen and for pure deuterium. The partition coefficient for either component is therefore not independent of the presence of the other component. This conclusion was further verified by the fact that following a series of runs with hydrogen, it was necessary to "condition" the column by several runs with deuterium before a reproducible value for the retention volume of deuterium could be obtained.

215 pages. $2.80.

USE OF AN UNBALANCED BRIDGE CIRCUIT IN HIGH-FREQUENCY TITRIMETRY

(L. C. Card No. Mic 58-1270)

Joe Melvin Walker, Ph.D.
Kansas State College, 1958

The purpose of this investigation was two-fold: the first being to develop a number of mathematical relationships relating low-frequency specific conductivity to high-frequency admittance changes. The second was to investigate the feasibility of using a modulated off-balance radio frequency signal originating from the detector side of a high-frequency impedance bridge as a method for performing high-frequency titrations.

Several relationships were derived relating admittance changes to specific conductivity changes.

The use of an unbalanced bridge circuit in performing high-frequency titrations was found to be quite applicable. An equation was formulated relating the unbalance of the bridge, measured experimentally by the voltmeter, to that of the true admittance obtained under balanced conditions. It was shown that the derived admittance equations could be used in predicting the experimentally determined voltage response curves.

Several typical titrations were performed with various electrolyte concentrations. The effective high-frequency admittance changes were correlated to the low-frequency specific conductivity changes in several cases. It was shown that by shifting the specific conductivity titration range, the response curve would change in a manner predicted by the experimentally determined transfer plot for that particular frequency. The effect of the dielectric constant of the solvent was shown to follow the equations derived for the admittance values.

It is believed that the use of an unbalanced bridge circuit shows much promise for performing high-frequency titrations. Because most instruments available at the present time operate at a single frequency, altering cell design and solution characteristics offers the only method of obtaining improved response. By making use of the unbalanced bridge circuit, a single cell may be used over a wide response range in terms of specific conductivity by changing the frequency of measurement.

110 pages. $2.00.

ECONOMICS, GENERAL

UNCERTAINTY IN AGRICULTURAL PRODUCTION AND PUBLIC POLICY

(Publication No. 25,433)

James Lomen Athearn, Ph.D.
The Ohio State University, 1953

Agriculture is the largest sector of the U. S. economy which is characterized by most of the features of a purely competitive market. In spite of this fact, chronic disequilibrium persists and the allocation and utilization of resources in this important industry are far from the optimum of a competitive, long-run adjustment. These chronic maladjustments which characterize agriculture are generally known as the "farm problem."

The existence of the farm problem is reflected in low incomes for many farmers and highly unstable incomes for all. Low returns to labor in agriculture as compared with other industries are an indication that too much labor is being combined with other resources. This is largely a result of the relative decline of agriculture and the fact that the rural-to-urban movement—large as it is—does not relieve the population pressure in rural areas. Highly unstable incomes are a result of the instability of demand and the relative inelasticity of supply and demand.

Because of the importance of agriculture, the farm problem is one of the major economic problems facing the United States. It is of interest to students of economics because of the waste of resources that results and because of possible changes in public policy to reduce some of the waste. Since agriculture closely approximates the competitive model, its operation also gives an insight into the efficiency of the semi-competitive system.

The price system and the competitive market have been considered the ideal allocating mechanism in a capitalistic economy. In agriculture, however, prices have not been an adequate guide to production, as is indicated by chronic surpluses and shortages of agricultural commodities. One explanation of the inefficiency of the market mechanism may be found in the way in which farmers formulate and interpret price expectations. Where future prices are unknown, but must be estimated in order to be used as guides to production, uncertainty exists.

The theory of uncertainty, in a sense, fills the gap between the purely competitive model and operating conditions. Future prices known with certainty are one kind of guide in decision-making, but future prices estimated with less than complete confidence are a different kind of guide. The theoretical structure which is designed to explain the nature and significance of this difference is divided into two parts. One part is an explanation of expectation formulation. The other part is concerned with reactions to the uncertainty with which expectations are held.

One view of expectation formulation is that the entrepreneur ranks possible outcomes in the order of the degree of surprise which would be associated with each outcome. A second view is that the individual ranks the various outcomes in the order of their probabilities. Cardinal values are not assigned to the probabilities, but they are ranked in an ordinal sense to facilitate comparison. Others take the position that the individual assigns cardinal values to the probability of each of a series of outcomes in order to compare them and form his expectations for the future. The differences in these approaches to an explanation of expectation formulation are not as great as they may appear to be. They all assume that consideration is given to a large number of possible outcomes and that the various possibilities are ranked in some way for purposes of comparison. They differ slightly, however, on the question of how the individual evaluates each possible outcome.

Theoretically, reactions to uncertainty are positive and involve an emphasis on flexibility, short-run plans, liquidity, insurance, and diversification. Flexibility and short-run plans are desirable because expectations are held with less than complete confidence and, in many cases, the belief is held that information becoming available in the future will involve modifying plans. Liquidity is preferred because the firm is better able to withstand adverse developments and can take advantage of unusually favorable opportunities without having to depend upon creditors. Insurance is bought to guarantee the survival of the firm in the event of a disaster and also because the conservatism such a purchase denotes improves the position of the firm with regard to borrowing in the event that the necessity should arise. Diversification of production activities is designed to stabilize income by having high returns from one enterprise offset the low returns from another. Uncertainty makes "putting all the eggs in one basket" undesirable so far as the typical entrepreneur is concerned.

Because reactions of the type described above are made by individual entrepreneurs who are also reacting to various other elements in their environment, an objective measurement of the cost of reactions to uncertainty is extremely difficult. No part of the theory of expectation formulation or reaction to uncertainty attempts to quantify the significance of uncertain future prices in the market, but the inference is that a less-than-optimum use of resources results from the existence of uncertainty.

Because agriculture is characterized by a great deal of uncertainty, empirical investigations in this industry provide an ideal opportunity to test the theory of uncertainty. Farmers are faced by market uncertainty which involves the question of future prices. Moreover, the production process is unpredictable because the farmer does not have complete control over all the inputs. Farmers are also confronted with uncertainty about political programs which will affect the market for their output.

A survey of studies concerning uncertainty in agriculture made in Iowa and Kentucky revealed that uncertainty is a factor of major importance in farm management. One of these studies involved personal interviews with farmers to determine their attitudes toward borrowing funds. Information from this source indicated that uncertainty resulted in internal capital rationing among many of the

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farmers contacted because borrowing reduces the equity of the borrower and increases his fixed expenses.

Another study reviewed involved an analysis of price and yield fluctuations in the period 1917-1948 in various townships in Iowa. The significance of such fluctuations was illustrated by setting up hypothetical farms engaging in different enterprises and then measuring the variability of net income resulting from the instability of prices and yields during the previous thirty-year period. If farmers consider yield and price during such extended periods when forming expectations for the future, such a study has significance in measuring uncertainty. However, if farmers use current yields and prices as the basis for estimates, or very recent data, then the validity of historical studies of price and yield fluctuations as a measure of uncertainty is questionable. Other studies of net income fluctuation in the past as a measure of present uncertainty are subject to the same criticism. Such studies can, however, indicate farm management plans which will reduce fluctuations in net income through diversification and an emphasis upon crops with relatively stable yields. This is true also of studies of net returns from various types of livestock feeding systems.

Another study included in the survey was based on personal interviews with 200 farmers designed to determine their expectations with regard to yields and prices. A comparison of these expectations with subsequent results indicated that farmers can predict yields more accurately than prices. However, most farmers were able to predict a range of prices within which actual prices fall.

The last study reviewed was concerned with pasture utilization in Kentucky. The object was to determine farmers' reactions to the variability of pasture yields which results from variations in the weather. The conclusion drawn was that farmers' fear of drouths prevents them from making a full utilization of pasture. Many of them understock to avoid any possibility of feed shortages. This results in some waste of pasture in most years. Plans are obviously made on the basis of minimum estimates.

In summary, these studies indicated that uncertainty concerning future markets is more important to farmers than yield uncertainty but that the latter also affects plans and actions. Confidence with regard to yield expectations may be more characteristic in an area with relatively stable climatic conditions, such as the Corn Belt, than would be the case among farmers in an area where rainfall fluctuates considerably from year to year. The studies reviewed indicated that farmers behave conservatively because of the uncertainty with which estimates and prices are viewed. Some evidence of an emphasis upon liquidity and internal capital rationing was found as well as the existence of a preference for short-run plans.

The present study involved a survey among Ohio wheat and corn farmers to determine how yield expectations are formed and the uncertainty involved. The results of this survey indicated that in Ohio, farmers are not highly uncertain about yields but have a tendency to plan on the basis of conservative estimates. Most wheat and corn farmers estimate the most probably yield on the basis of an average of recent experience. This expectation and the minimum yield which may be expected are apparently important for planning purposes. Maximum yields which may be expected, however, seem to have little bearing on plans. There was no indication from this survey that farmers weigh and consider carefully a multitude of possible outcomes, assigning probabilities to each or ranking them according to the likelihood of their occurrence. So far as yield expectations are concerned, most farmers appear to have one or two estimates which they would consider most likely and perhaps one more which they would consider a minimum. These farmers did not rank a whole series of expectations ordinally, nor did they assign cardinal numbers to the degree of probability connected with each. Their expectations do not shade off gradually from most probable to minimum, with attention being given to each possibility in between. Rather, attention is concentrated on a few estimates of outcomes which would be most significant to the individual concerned.

A survey among Ohio commercial cattle feeders to determine their expectations concerning future market conditions indicated that considerable uncertainty exists in this area. For the group as a whole, price expectations are widely distributed. For many individuals, the range of expectations is so large as to indicate a very uncertain outlook. Under these circumstances, it is interesting to note that many farmers used current market prices as their estimate of future prices. Furthermore, many of them were uncertain as to future feeding plans or were planning to follow the same plans as in the past. Both these behavior patterns are consistent with theoretical explanations of reactions to uncertainty. Exceptions to this reaction (where low price expectations were accompanied by plans to expand feeding operations) were found to result from situations in which price was relatively less important than other factors.

The cattle feeders survey indicated tnat farmers do not react quickly to their own price expectations. This is partly attributable to uncertainty but is also a result of the relatively inflexible character of farm management plans in the short-run. A farmer equipped to feed cattle does not change plans quickly, especially if his feed supplies are large and opportunities for other enterprises are not numerous. Changes in price expectations do not affect production in the short-run because farmers are uncertain as to the future trend in prices and production plans cannot be changed quickly and easily for technical reasons.

Uncertainty is significant only to the extent that it affects adversely the allocation and utilization of resources. The problem here is two fold. One aspect of the problem is to show that resource use and allocation in agriculture is inadequate. This can be shown by comparing returns to labor and other factors in agriculture with those in other industries. The second aspect of this problem is to demonstrate the role of uncertainty. The major difficulty involved is that farmers react to a total situation and uncertainty is only one aspect of their environment. For this reason, an objective measurement of the cost of reactions to uncertainty is not feasible. However, a qualitative demonstration can be made. For example, when farmers consistently make plans on the basis of conservative estimates, marginal costs and marginal returns will seldom be equated. Those who refuse to make investments because of uncertainty even when they think that the returns would more than pay the cost of borrowing are failing to maximize their profits. This prevents the price system from allocating resources and guiding production efficiently. Failure to maximize incomes indicates that resources are not being used as efficiently as they would be if expectations could be held with perfect certainty.

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When entrepreneurs as well as lenders stress liquidity and insurance considerations because of uncertainty as to the future, resources are prevented from being used directly in the production process. Flexibility considerations prevent the adoption of an optimum plant. On the other hand, a lack of flexibility combined with uncertainty may result in a temporary disregard of price expectations. This prevents the price system from performing its function of guiding production, at least in the short-run.

The fact that the cost of these reactions to uncertainty cannot be calculated in terms of dollars and cents does not detract from their economic significance. Instead, their existence points up one reason why the market mechanism has functioned unsatisfactorily as a guide to production and the allocation and use of resources in agriculture.

A recognition of this failure has resulted in two types of proposals to make the market work better. One proposal brought into existence the outlook service for farmers. The purpose of this service is to keep farmers informed with regard to trends in supply and demand for particular commodities. The idea is that with information of this type at their disposal, individuals will make the necessary adjustments in production. For several reasons, this program has not met with the success which was originally predicted for it. First, farmers are not guided solely by price considerations. Second, farmers do not have complete confidence in price predictions when they are not guaranteed. Third, as individuals, farmers fail to appreciate the significance of their production to the total supply. A fourth possible reason is that such information does not reach enough farmers or they do not know how to interpret it. Very little is known about this point.

Because outlook services were not capable of solving the farm problem, more direct interference with the operation of the market mechanism has been advocated. Programs in operation during the last twenty years have involved attempts to guarantee prices and help farmers to cooperate in controlling production. The operations of the Commodity Credit Corporation have been successful in reducing short-run price uncertainty but uncertainty with regard to maximum possible prices and long-run trends still prevails.

Because of the practical difficulties experienced under programs pursued thus far, other plans have been suggested. One of these is forward pricing, under which a price based on estimates of supply and demand would be guaranteed each season. This is essentially the outlook service with a guarantee. Another plan suggested is that of compensatory payments. Under this plan, farm prices would be set by supply and demand but the adverse effects of downward cyclical price fluctuations would be offset by compensatory payments to the farmers. Prices would be such that markets would be cleared and there would be no interference with international trade, such as has occurred under past and current programs.

Forward pricing would not eliminate uncertainty about prices in the long-run. Compensatory payments would eliminate only uncertainty which results from cyclical fluctuations. Thus, with either program uncertainty would be reduced but not eliminated.

The suggestion here is that these two programs be combined so that both short-run and cyclical price uncertainty could be eliminated. This suggestion is made because short-run changes in prices do not serve adequately as guides to production and cyclical fluctuations in prices are not satisfactory as indicators of what the allocation of resources should be in the long-run. Present administrative machinery could be adapted to this program quite easily and the experience of the Commodity Credit Corporation should prove helpful in administering the program.

With a growing, dynamic economy, uncertainty with regard to long-run trends probably cannot be eliminated. Past programs to shield farmers from the adverse effects of secular changes have resulted in a failure to adjust resource allocation in the long-run. Perhaps the best that can be done is to eliminate short-run uncertainty and that which results from cyclical fluctuations, while at the same time encouraging adjustments to long-run trends in supply and demand. This is essentially the objective of the program suggested here. The costs of such a program would probably be offset by the improvement in resource allocation and use which would result.

272 pages. $3.50. Mic 58-4803

Abstract published by special arrangement with The Ohio State University.

THE LIMITATION OF THE WORK WEEK: AN ANALYSIS OF ITS RATIONALE, ENFORCEMENT, AND ECONOMIC EFFECTS

(L. C. Card No. Mic 58-886)

Tony Brouwer, Ph.D.
University of Michigan, 1957

This dissertation is an analysis of the reasons for and the economic effects of the movement to reduce working hours and the adoption of premium rates of pay to control overtime. When the movement to reduce hours began, hours of work were unduly long. Under the requirement of efficient operations, the modern industrial enterprise had to enforce uniform work schedules. As a result, the adjustment of hours to conform to worker preferences through the process of individual bargaining was limited. The movement to reduce standard hours was an attempt to resolve this social problem by collective or community regulation.

Although legitimately a problem justifying state regulation, the state and federal governments were hampered by legal restrictions, economic philosophies, and judicial interpretations of constitutional provisions. Legal controls were gradually imposed, however, for limited groups of workers. Not until the depression of the 1930's was federal legislation enacted limiting hours for workers in interstate industry generally, and then only on the spurious ground of reducing unemployment.

Meanwhile, the trade union movement assumed the responsibility for imposing collective control over hours for its own members. Through direct, independent collective bargaining action, the standard work week of union members was reduced to as much as ten hours less than that of the unorganized. At the same time, it was recognized that the problem of protection against the lengthening of hours was as important as that of reducing hours. The premium rate was developed as a flexible deterrent to overtime work.

The economic effects of shorter hours and overtime

premium pay cannot be ascertained without a knowledge of the relationship between hours of work and output. Studies of this relationship have indicated that with the reduction of hours below eight per day and forty-eight per week, total output tends to decline, but output per man-hour tends to increase. Upon this basis, trade union efforts to reduce hours further present a new problem for society: the substitution of leisure for increases in real income.

The trade union arguments that shorter hours will raise real wages or reduce unemployment are found to be largely illusory. Only inder limited conditions will the real wages of specific groups of workers be improved, and then only at the expense of consumers and other workers. Unemployment will be alleviated by shorter hours only in the sense that it is spread more evenly. The effect of further reduction will merely provide workers with greater leisure at the expense of potential increases in real income to society, and to themselves. Only when leisure, as an economic "good", is included in the concept of economic welfare can one say that the well-being of wage earners is improved by shorter hours. This will occur if the increased leisure is valued more highly by the wage earners than the potential rise in their real income.

The introduction of the premium rate results generally in the safeguarding of the workers' gains in leisure, and in the curtailment of increases in the real income of the total population. Only in limited situations, in which employer increases in revenue or savings in cost provide temporary offsets to the increased costs of overtime, will extra hours be worked.

During war-time, however, the premium rate does not impede maximum production, and may even help to expand essential production faster than otherwise by contributing to an effective system of man power mobilization. It facilitates a rapid increase in the utilization of existing productive facilities, and contributes to the effective allocation of the available labor supply. The premium rate provides a useful, already established, and less inflationary means of mobilizing man power resources during wartime than the alternative method of adjustment in the basic wage rate.

275 pages. $3.55.

AN ECONOMIC ANALYSIS OF CONSUMER FOOD BUYING HABITS OF NEGRO HOUSEHOLDS, IN COLUMBUS, OHIO

(L. C. Card No. Mic 58-783)

George Theodore Dowdy, Ph.D.
The Ohio State University, 1952

One of the great American fallacies is the oft-repeated statement that "the customer is always right." Though the meaning I am giving that phrase may be more literal than justified, the statement does emphasize in a paradoxical way a serious weakness in the marketing process. For without a more enlightened and more informed body of consumers, marketing can never be as efficient as it might be.

While the customer, or consumer, may be far more often wrong than he is right, there exist possibilities within the marketing system that the consumer may become more nearly right, more often, through wider consumer education. Naturally, if this result were reached, it would have significant influences upon the marketing framework and the problems that beset marketing. These influences have repercussions all the way from the consumer to the producer.

To feed a family adequately, a consumer is called on to handle a difficult job. He goes to the store at least once a week and buys a supply of food for the family. Since the bill for food usually takes the biggest slice of the entire family income, the habits formed in the expenditure of money for food are of great importance.

All consumer food buyers approach the food counter with a common purpose, for in shopping for food they are buying commodities that are essential to life itself. Moreover, they are doing a job that is important not only to them, but to many others as well. The success with which the housewife does her weekly shopping is of great importance to her family, to the retailer, to the wholesaler, and to some extent to transportation, and the farmer, since the job of marketing the farmer's products is not really done until the food is on the family table.

The methods by which consumers buy food vary widely, as do also the degree of success they achieve and the economy of their practices.

In the words of Persia Campbell, "food 'habits' are conditioned by all kinds of custom, taboos, and prejudices, as well as individual tastes and attitudes, developed from infancy."[1] Special food habits are peculiar to many countries and communities. New England pie, southern corn bread, Mexican tortillas, Irish bacon, Scotch porridge, German sauerkraut, and Chinese rice are distinctive foods, fixed in consumption by long custom. Sometime such customs work great hardship on those who practise them.

Quite obviously, food-buying habits are also to a very great extent controlled by custom, national as well as local. Most of the practices followed in buying food are the result of the interaction of a number of factors.

PURPOSE

The study was undertaken to determine what effects the following factors have upon the food-buying habits of Negro families in Columbus: (a) family income, (b) number of days groceries are bought, (c) the day most groceries are bought, (d) main sources of supply, (e) amount spent for beverages, (f) amount donated to the church, (g) amount spent on amusement, (h) geographic place of birth of housewife, (i) time of day purchases are made, (j) self-service versus service by a clerk, (k) planned purchases versus unplanned purchases, and (l) purchases at one store exclusively versus purchases at different stores.

The writer feels that the findings of this study should contribute to improved buying practices and consumer education. According to Maynard and Beckman, one of the most important functions of the wholesaler is to anticipate customer requirements. This cannot be done without an intimate knowledge of the needs of ultimate customers who buy from the retailers which the wholesaler serves. Variations in demand in different parts of the territory such as those based on color, race, religion, and economic status must be kept in mind and the corresponding purchases made. Thought must be given to changes in custom or income which indicate the wisdom of dropping or adding certain items.[2]

Finally, in regard to purpose, the author desired to

seek some information on the comparative importance of neighborhood groceries owned largely by individuals and operated as small independent businesses and chain stores organized in corporations for the purpose of centralizing management. Is it true that the enormous buying power of the chain companies, coupled with the fact that credit is seldom extended and deliveries rarely made, permits them to make prices so attractive that housewives from the universe studies were predominantly shopping in chain stores instead of patronizing neighborhood or independent stores which generally offer credit and delivery and usually feature the appeal of service?

SUMMARY

1. A total of 340 Negro families were interviewed in Columbus, Ohio, during the spring of 1951.

2. The amount of income received by the family had a pronounced influence on the average amount spent per week for food. For example, families with an annual income of less than $1,000 spent an average of $16.35 per week for food, while families with an annual income of $6,000 and over spent $37.68, or more than twice as much as was spent by families with an income of less than $1,000.

3. Food expenditure per family did not increase in proportion to an increase in the size of the family.

4. The purchases of items other than food were somewhat in conflict with expenditures for food. Families in the lowest income class who were not buying furniture, clothing, etc., spent $5.50 more for food than their counterparts who were purchasing other things.

5. There was a direct relationship between the size of family income and weekly expenditure for fresh meat. The lowest income class spent only half as much for fresh meat as the highest income class.

6. Negroes spent about 50 per cent more time than the average family in the effort to satisfy their needs for fresh vegetables. In certain areas many Negroes lived in close proximity to fresh fruit and vegetable stands. This, together with the fact that an appreciable number of them were still patronizing street peddlers, may account for most of the differential.

7. There was a very impressive relationship between the level of family income and the index of expenditures for fresh fruits. The index for the lowest income class was only 49, while for the highest income class it increased to 204. This suggests that this population will constitute an increasingly good market for fresh fruit as its income advances.

8. The average amount spent per week on fresh milk did not increase very rapidly with an advance in the level of income. As the income level increased, the source of supply of fresh milk changed from the independent stores to the milk distributors.

9. The index of weekly expenditure for beverages increased consistently as income increased.

10. Families who had an income of under $5,000 donated, on the average, more to the church and spent less on food than did families with incomes over $5,000. Consequently, it might be said on this basis that church donations do interfere to some extent with food expenditures.

11. Seventy-five per cent of the families considered in this study made no plans before shopping; they simply entered the store and chose their foods without forethought.

12. As compared with only 38.3 per cent for all families in Columbus, 52.6 of the Negro group bought most of their groceries on Saturday. About one-half (49.0 per cent) of all Negro families who shopped on Saturday did so, they said, because it was their payday, while 24 per cent gave habit as the reason.

13. Families that owned their homes showed less tendency to shop for most of their groceries on Saturday. Housewives who had less than an eighth-grade education were strongly inclined to Saturday shopping, while college graduates accounted for most of the families who shopped from Monday through Thursday.

14. About 50 per cent of all Negro families who shopped for food four times a week said it was just a habit, while the remaining 50 per cent gave "lack of proper storage space" as their reason.

15. About 20 per cent of all Negro housewives of southern birth shopped from 3 to 4 times a week in order to satisfy their grocery needs, while those who were of northern birth did all of their shopping within one to two days. Low educational status of the housewife is directly related to an increased number of visits to the food store during the week.

16. Eighty-three per cent of all families who shopped four times a week for fresh fruits and vegetables said they did not have "suitable storage space to keep them fresh in the home."

17. Ninety per cent of the all-families group were apparently well satisfied with self-service, but only 59.4 per cent of the Negro families expressed such satisfaction. The services of grocery clerks was preferred chiefly by Negroes in the low income group, more than fifty per cent of whom stated that it was easier to be waited on. Second and third in importance as reasons for using clerk service were "habit" and "use of credit."

CONCLUSIONS

Analysis of the findings of the study indicated in no uncertain terms that there is a great potential increase in patronage of the food market awaiting the day when Negro families in Columbus, Ohio, earn higher incomes. The above statement is particularly true as it concerns fresh meats and fresh fruits. However, these data showed that the Negro has a pent-up normal desire for other things than food, and until there is enough money to satisfy this desire and at the same time pay for the proper quantity and quality of food, expenditures for food will be too low. As income increases, the chains and supermarkets may expect greater patronage from this racial group, expecially for fresh fruits and vegetables. Suppliers of food to this group may continue to expect Saturday to be the main shopping day for a considerable period of time. However, they should continue to place emphasis on Friday as the day of "better bargains" because the majority of families who shopped on Friday gave "better bargains" as their reason for doing so. Generally the status of education was found to be of great importance in studying the food-buying habits of Negroes. As the educational status

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increases, food stores may expect a slightly larger dollar volume in trade, with definitely fewer visits. Educational agencies should make an effort to teach consumers how to plan their food purchases in such a way that they may not suffer from competition with other purchases.

The interpretation and evaluation of the data relating to consumer food-buying habits and attitudes are available to those who desire to apply the findings of this research to a similar study in some other section of the United States. 176 pages. $2.30.

1. Campbell, Persia, The Consumer Interest. New York: Harper and Brothers, 1949, p. 326.

2. Maynard, H. A., and Beckman, T. W. Principles of Marketing. 4th ed. New York: Ronald Press Company, 1946.

Abstract published by special arrangement with The Ohio State University.

AN ANALYSIS OF PROCESSING COSTS IN SPECIALIZED BUTTER PLANTS RECEIVING WHOLE MILK

(L. C. Card No. Mic 58-1121)

Arvid Cornelius Knudtson, Ph.D.
University of Minnesota, 1957

Minnesota's Cooperative creamery industry is undergoing considerable change. Improvements in transportation and processing techniques have increased the competition among plants by increasing the sizes of supply areas and increasing plant efficiencies. The competitive struggle for increased volume has caused many plants to lose volume and close, while other plants have increased in size. The net effects of these changes over the last 20 years have been a 38 percent decrease in plant numbers to 542 plants in 1956: and during the same period there was an 83 percent increase in annual plant volume, to 521,000 pounds of butterfat in 1956.

Even though these changes in volume and plant numbers have occurred the industry is still characterized by rather small plants. Two hundred and fifty-nine of the plants in the state still have annual butterfat volumes of less than 500,000. A recent cost study showed that plants of this size had an average processing cost of 6.86 cents per pound of butterfat while larger plants, plants with annual volumes over one million pounds, have reported processing costs as low as 3.3 cents per pound of butterfat.

Adjustments to changing technologies through the competitive process are slower than necessary in a cooperative industry. Planned reorganizations is the method being used to achieve the necessary adjustments more rapidly and efficiently.

Considerable information is needed for intelligent planning. Cost information is needed on the various types and sizes of alternative dairy organizations and cost information is needed on farm to plant and interplant transportation of milk.

The basic data used for this study were obtained from four carefully selected plants. They were selected because; 1) they represented a wide range of volumes, 2) they received only whole milk, and 3) they sold only butter, skimmilk, and buttermilk.

The range in plant volumes covered by the four plants was from 32,000 pounds to 178,500 pounds of milk per day.

The four sample plants furnished the basic data from which model plants were developed. Improvements were made in the equipment and plant organizations where possible to make them approach as near ideal conditions as possible.

The annual average total cost functions for the four model plants decrease over their entire ranges. Each of the average cost functions would turn abruptly upward at the physical capacity of the plant -- a lack of storage for skimmilk, wholemilk and buttermilk would cause spoilage of the product and increase costs.

Economies were found associated with increased volume. Economies in this case are associated with increased volume for two main reasons: First, larger capacities in equipment reduce per unit equipment costs. For example, annual equipment costs for the smallest plant were $9,234 while the annual equipment cost for a plant five times as large were $16,516. Second, larger sizes of equipment facilitates more intensive use of labor, there are less operative delays per unit of output.

The economies of size decrease at a decreasing rate throughout the range of volumes covered by the four plants. At volumes beyond the volume of the largest plant there would be problems associated with direct can receiving. At these larger volumes it would be necessary to add another can washer and extra receiving labor. And, truck scheduling for such large volumes of milk may become a problem in direct farm to plant delivery.

199 pages. $2.60.

ECONOMICS, COMMERCE - BUSINESS

OVERHEAD COSTS OF PRODUCTS -- ACCOUNTING AND MANAGERIAL VIEWPOINTS

(L. C. Card No. Mic 58-887)

Richard Lee Brummet, Ph.D.
University of Michigan, 1957

The purpose of this study is to survey and examine critically a variety of concepts of overhead cost assignments to products in view of several purposes for which product cost information is required. Justifications for such a study are as follows: (1) overhead costs represent a substantial portion of total costs of manufacturing enterprises, (2) the association of overhead costs with product units has a significant effect upon net income calculations and inventory valuations, (3) management functions and many management decisions should be based, in part, upon product cost information, and (4) controversies and some misunderstandings exist among both accountants and business managers in the area of overhead costing.

The general problem of overhead costing of products is examined and the historical development of product overhead cost concepts is traced in the first part of the

study. This is followed by a discussion of overhead costing of products as it relates to professional accounting with its emphasis upon income calculation and inventory valuation. It is shown that reported net income varies in direct relationship with changes in the overhead cost content of inventories. No conclusions may be drawn with regard to relative conservatism of various concepts of product overhead costs. Over the long run all concepts yield the same income result, but the concept used may be a material factor in annual and shorter-period calculations of net income.

It is concluded that for financial accounting purposes (1) there is no rational basis for the by-passing of the product cost category by all production overhead costs, (2) circumstances often make it inappropriate to assign all recorded production overhead costs as product costs during a period of a year or less, (3) behavior patterns of certain overhead costs are not necessarily relevant to the problem of tracing costs to inventoriable product units, and (4) long-run expectations of plant utilization and operating efficiency provide the most appropriate bases for determination of overhead charging rates.

The third part of the study relates to the problem of harmonizing historical net income figures with those provided by break-even types of analyses. A technique is developed to enable short-term forecasting of profits as a function of both sales and production volumes and to assist in the understanding and interpretation of net income computed by conventional and generally accepted accounting procedures.

In a final section of the study product overhead cost concepts are examined from management's viewpoint. Special emphasis is given to product cost concepts most useful for pricing decisions and for the control of costs. It is concluded that for pricing decisions (1) overhead cost information should involve projections of future costs, (2) under many if not most circumstances an awareness of incremental unit costs is essential, and (3) long-run price policy should be based, at least in part, upon total product cost calculations including overhead costs in order to maximize over-all profitability.

In the area of cost control overhead cost concepts should be used to motivate responsible employees and provide variance data for the administration of cost control plans. In general, it is concluded that full standard overhead costs based upon a reasonably high performance level at anticipated volume provide the optimum motivation, at least at the lower echelons of management, and that standards based upon a similar performance level at a practical capacity volume provide the most useful over-all variance information. 289 pages. $3.75.

SOME SELECTED PROBLEMS IN ACCOUNTING FOR EXECUTIVE COMPENSATION

(L. C. Card No. Mic 58-1335)

Norman Steffensen Cannon, Ph.D.
Columbia University, 1957

The study was designed to explore the current developments in the field of executive compensation with two objects in mind. The first was to determine the nature of the various compensation plans and the factors underlying their choice in the executive compensation program. The second was to consider the accounting problems associated with the new techniques and their solution.

Early in the study it became evident that while there were many plans for executive compensation in operation, the great majority could be classified in four groups; the pension plan, the stock option, deferred profit sharing, and deferred compensation contracts. For reasons explained in the text this study is devoted to the three plans last mentioned.

Material for the study was obtained from the available literature in the accounting, legal and business areas, a study of the proxy reports and the annual reports to the Securities and Exchange Commission of some 66 companies, and from letters received from various companies that were requested to supply information not contained in the published data available.

The influence of the Federal income tax on all forms of executive compensation is so significant that an attempt to compare the merits of the plans on a basis of popularity is doomed to failure. This is demonstrated dramatically by the experience with the stock option plans which were comparatively unpopular until given preferential treatment in the Revenue Act of 1950. They are now, according to the study, by far the most popular of the three plans.

An objective examination of the three types of plans indicates that the stock option and the deferred compensation plans are competitive in their objectives, whereas the deferred compensation contract tends to serve a more specialized purpose that is complementary to the objectives of the other plans. Of course, all three methods are competitive in that they present alternatives for reducing income tax to the executive. There is evidence that certain forms of the deferred profit sharing plans could more effectively accomplish the incentive purposes for which the stock option plan is designed if the tax treatment is comparable.

The accounting problems encountered in the study were not numerous, but some were found to be stubborn and knotty. In connection with the accounting for stock options the primary problem involved the decision as to when and how to measure the compensation in the stock option. Evidence of the difficulty involved in the solution of this problem is found in the fact that the Committee on Accounting Procedures of the American Institute of Accountants found it necessary, in 1953, to make a substantial change in the Accounting Research Bulletin No. 37 that it had issued on the subject in 1948. The fact that the Securities and Exchange Commission at first refused to recognize the findings in the new bulletin and subsequently was forced by the weight of public opinion to propose a compromise is further evidence of the difficulty involved. The conclusion reached in the study was that until the measurement problem can be solved, a strongly-worded footnote indicating the existence of unreported compensation in the form of stock options should be used.

The major accounting problem associated with the deferred profit sharing and deferred compensation contracts involved the recognition of the expense and liability for the deferred compensation. Particular difficulty is experienced in settling the question raised by the fact that deductions for tax purposes are permitted in periods other than that preferred for the expense deduction. Should the

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liability reflect the full amount of the deferred payment or should it be reduced by the anticipated savings?

250 pages. $3.25

THE MARKETING OF COLORIZER PAINT (A CASE STUDY OF AN INNOVATION DEVELOPED BY BENNETT'S, A REGIONAL PAINT MANUFACTURER LOCATED IN SALT LAKE CITY, UTAH)

(L. C. Card No. Mic 58-686)

William Henry Day, Ph.D.
The Ohio State University, 1953

The contemporary economic system of the United States is highly competitive and dynamic. Although some legislation may have the effect of restricting competition,[1] at least in the short run, competition is nevertheless regarded as an essential element in the functioning of the system. Non-price competition in American capitalism has tended by and large to take the form of product differentiation. Furthermore, product differentation has come to be not only a common form of innovation but also a significant source of short run profits.

Today competition is keen in many industries, including, of course, the paint industry. The present study was undertaken, therefore, in order to examine a new innovation which has attained significance in the American paint industry. This paint innovation is called Colorizer,[2] a concentrate colorant packaged in a tube (similar to a tube of toothpaste) separately from the base paint. The paint itself is produced as white base for regular colors, and as gray base for deeper colors. By combining a quantity of base paint and the necessary tubes of Colorizer, a purchaser may acquire any color he chooses from an almost unlimited assortment.

In making the study, the writer made extensive use of personal interviews, field surveys, and individual correspondence, and placed major emphasis upon a case investigation and analysis of Bennett's, an independent regional paint manufacturer in Salt Lake City, Utah.

The study attempts to follow through developments in one area of the economy in an attempt to discover their effect on other areas. Consumer demand for paint has been affected by the increased interest in interior decoration and art, the changes and improvement in architecture resulting from technological developments, and the changes in consumer taste indicated in part by the trend towards naturalism.[3] All of these developments have contributed to the rising demand for more color. This awakening of color consciousness was accelerated following the Second World War. The emphasis on color has made it necessary for paint salespeople to become more adept in handling decorative problems, especially that of color coordination. To the American housewife this is represented by the difficulty of harmoninzing the various colors of her furniture, draperies, rugs, lamps, and wallpaper with her wall paint.

Accompanying the emphasis on color in recent years is a shift in advertising appeals. Formerly paint advertising emphasized rational appeals, the product's quality, durability, etc.; on the contrary, current advertising emphasizes emotional appeals--pride of home, color harmony, home beautification, and pleasanter living with proper color.

An important aspect of production for paint manufacturers is planning color, i.e., finding appropriate colors in the face of a constantly changing color market. Authorities on the subject feel that the present awareness of color is not a fad, but an important aspect of experience. The buying public's level of color appreciation is now at its highest in the history of this country.

The attitude of business management towards consumers has, in general, changed. For many years management dictated colors, styles, and fashions. It took some manufacturers longer than others to realize that production is for the consumer, not the consumer for production. Since paint manufacturers, in particular, were slow to change their thinking, progress in the industry was retarded. In spite of recent progress, some paint manufacturers still do not appreciate the fact that a sound marketing plan, whether from the point of view of the manufacturer, the wholesaler, or the retailer, should begin with the consumer. Only in satisfying consumer wants can the businessman derive his profits and justify his existence.

Moreover, the investigation corroborates the view that consumer analysis has become a more difficult task as a result of the increased number of outlets, changes in buying habits, acceleration of fashion changes, rise of style consciousness, and the invention of new materials which characterize today's business. Bennett's deliberately chose to find out who their customers were, what they wanted, and how the company could better serve them. Thus, the management of this firm utilized a business fundamental, consumer analysis, to help focus attention on the underlying needs of their business. Results of a consumer survey indicated that women are the principal customers in the retail paint field and that they are not interested in paint per se, but in color for beautifying their homes. Recognition of this fact prompted Wallace F. Bennett[4] to undertake research and experimentation in order to provide a suitable means for satisfying consumer demand for more color. This research commenced in 1932 and continued up to 1947, when the improved Colorizer was introduced to the public.

In the process of expanding color assortment Bennett's researchers discovered that they had developed too many colors without providing a complete and well-balanced range which could be merchandised profitably. Having a vast number of colors was, therefore, not the solution. Some more fundamental method was necessary, and it was found to exist in a scientific treatment of color presented by Wilhelm Ostwald.[5] This color theory is explained in terms of a color "world," the sphere being divided into two cones, with twenty-four strong bright basic colors arranged around the "equator." At the north pole is the one extreme, white, and at the south pole the other extreme, black. At the equator the primary colors are found, and as they are mixed with the light color, they gradually become lighter in value until white is attained. Moving from the equator towards the south pole, the colors increase in value until black results.

Bennett's also found that the economic law of dimishing returns seemed to apply to the number of colors which could be successfully merchandised. With over 5,000 colors it was almost impossible to classify, catalog, or satisfactorily handly such an enormous number. The experience of this company also revealed that a multicolor paint system must be intelligently displayed and that colors are shown to advantage when different hues are

presented on the same spread of a color book. This became a guiding principle.

The advantages claimed for Colorizer are: (1) adequacy of color assortment, (2) greater color stability, (3) approximately 75 per cent reduction in inventory and shelf space, (4) increased turnover, (5) approximately 50 per cent reduction in stock investment, (6) flexibility of color, (7) attractive display, and (8) no obsolescence.

Due to a shortage of critical materials essential to the production of base paint in 1947, it became necessary to modify the proposed production and marketing plan. Widespread distribution of the product had been achieved in the Intermountain region, and operations had been initiated in Southern California before the problem became acute. Consequently, Bennett's decided to bring about a horizontal integration of other manufacturers, each maintaining separate ownership. This plan provided the means for expanding the production of base paint. Colorizer was manufactured by Bennett's and distributed through the affiliated manufacturers on a royalty basis. Thus, the produce was given national and international market coverage through the incorporation of selected regional paint manufacturers in the United States and Canada.

This production problem had a profound bearing on the marketing of the product and obviated the necessity of distributing through regular wholesalers. Bennett's needed to incorporate manufacturers who could also handle their own wholesaling(wholesaling manufacturers), or else utilize other available channels of distribution. The following, in the order of importance, constitute the channels of distribution that were used: associate manufacturers, independent dealers, manufactuer owned stores, direct from factory to industrial users, and direct from factory to retail customers. The retail outlets, according to their relative importance are: (1) paint and wallpaper stores, (2) lumber dealers, (3) hardware stores, (4) general stores,[6] (5) appliance and furniture stores, and (6) department stores.

All of the manufacturers handling the product have subsequently organized a nonprofit corporation, Colorizer Associates, for the purpose of cooperatively coordinating merchandising efforts. The initial objectives of this organization were to build a nationally known brand name, to select influential experts on color in national advertising, and to expand market coverage at the local level. The advantages actually achieved were national advertising, services of color experts, a national publicity campaign, and the pooling of marketing and technical information. Not only is the product now marketed throughout the United States and Canada, but, in line with completed arrangements, it will also be introduced in Great Britain, New Zealand, Australia, South Africa, and Argentina.

The introduction of Colorizer produced some significant effects. It transformed Bennett's production from "tint" manufacturing to a "white line house,"[7] rapidly enlarged output, and increased sales volume at a higher rate than that of the industry as a whole. Surveys of dealers and consumers indicate general satisfaction. Moreover, favorable effects were secured on the cost of distribution and company profits. Finally, the effect on competition is indicated by the widespread imitation and emulation of the Colorizer principle by numerous firms in the industry.

Because the study involved an innovation, it was desirable also to consider the late Joseph A. Schumpeter's theory of innovation. The findings of this empirical study are generally consistent with the theoretical views held by Professor Schumpeter. He alleged that a new cost situation is maintained in consequence of the changes wrought by innovation. This does not imply operations at a lower point on the cost curve. New cost data, produced by innovation, are plotted graphically to produce a new cost curve. Although Schumpeter did not expand his explanation of the effect of innovation on demand, its effect is indicated by the substantial increase in sales (both in terms of units and dollars) which followed the introduction of Colorizer. The phenomenon, "clustering of innovations," which allegedly follows in the wake of successful innovation causes the profits of the innovator to vanish. This pheonomenon can be observed in the many new multicolor systems which are currently being introduced in the American paint market.

Colorizer paint satisfies for the most part the conditions of economic "development" set forth by Professor Schumpeter. It adds a new quality to a product, produces a new method of handling the product, opens a new market, brings into use new materials, and effects a new organization. Even so it may be necessary to broaden the economic concept of production to include marketing which is not explicitly treated in the Schumpeterian theory.

Bennett's was confronted also with the difficulties mentioned by Schumpeter as peculiar to innovations.[8] There were the resistance from social environment; reluctance and skepticism of dealers, painters, and consumers; the difficulties associated with divising new methods; and the difficulties arising from a lack of data for forming new decisions. These obstacles were overcome by a carefully planned marketing program which included a training and orientation course for all company personnel, a dealer campaign, a painter campaign, and a consumer campaign.

In some instances the study's findings differ from the Schumpeterian view. Schumpeter holds that innovation does not arise from a step by step process of change. Instead, it arises separately and distinctly as a discontinuous change without benefit of previous experience. Because it supposedly does not arise as a continuous change within an existing enterprise, it mush have independent origin, such origin assumes a new firm, new plant, and new men. The Colorizer innovation, however, neither arose as a discontinuous change, nor within a new firm.

Schumpeter devoted his treatment exclusively to innovations arising within industry and commerce; however, the innovations which do arise from the sphere of consumer wants should not be overlooked. Evidence from the study indicates clearly that Colorizer was conceived and developed in direct response to unsatisfied consumer wants. Schumpeter's failure to consider innovations arising from consumer wants seems to lie in his selection of a model which he viewed largely in terms of eighteenth and nineteenth century economic conditions, conditions in which the changes occurring in the field of consumer wants were for the most part omitted. Contemporary economic conditions in the United States present quite a different model in the sense that it is characterized by great opulence and unprecedented production. The role of marketing is significant in satisfying consumers through its demand-creation and want satisfying activities. Schumpeter's theory is best considered in terms of the particular model he selected. Due to the changes which have taken place in American capitalism--the increase in wealth, the multiplicity of consumer wants, the elements of "trustified

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capitalism"--the whole of the theory no longer applies, especially insofar as the present study is concerned. It appears, therefore, that the Schumpeterian explanation would seem more useful to the economic historian than to the student of the contemporary scene.

CONCLUSIONS

Within recent decades there has been an increasing utilization of art in manufacturing, merchandising, and the American home, resulting in a greater appreciation by consumers of aesthetic qualities. A demand exists for expanded color assortment in paint, and in working to modify a product to satisfy this demand, a paint manufacturer should base his modifications on fundamentally sound marketing considerations. A promiscuous expansion of color proved unsatisfactory from a merchandising standpoint. Bennett's found it necessary to standardize colors, classify, catalog, and provide a complete color system to handle the present-day consumer demand for more color in paint.

There is still opportunity for small firms in our competitive system, as this study indicates by showing how a small paint manufacturer with an innovation was able to expand operations from a regional basis to a national and international one. In the course of expansion Bennett's adopted the principle that the more kinds of outlets used in the distribution of a product, the greater the sales potential. This led to the abandonment of exclusive franchise distribution.

Product differentiation appears to have been a successful means by which the company met competition and overcame some of the problems of the depression which it faced. Moreover, the study corroborates a principle which has been stated variously and should be more widely applied by manufacturers of consumer goods. It is that consumer needs should be considered before a product is developed or modified. The Colorizer paint system based on the Wilhelm Ostwald theory of color arrangement and blending provides a practical solution to the problem of producing a great number of colors in paint. In addition it seems to resolve the controversy between sales and production personnel, with apparent mutual satisfaction, by simultaneously providing expanded color choice as well as standardization. 246 pages. $3.20

1. The Agricultural Marketing Act, the Agricultural Adjustment Act, the National Industrial Recovery Act, the Fair Trade Laws, the Unfair Practices Acts, the Chain Store Tax laws and other measures are indicative.

2. "Colorizer" is Bennett's registered trade-mark for the fluid paint colorant and related items of the same class.

3. Survey by House Beautiful magazine, January, 1951, reveals that Americans prefer to use naturalistic objects, colors, designs, fabric patterns, etc., in home furnishings.

4. Wallace F. Bennett was formerly President and General Manager of Bennett's. In 1948 he was President of the National Association of Manufacturers. He is now United States Senator from Utah.

5. German chemist, appointed professor of the Riga Polytechnikum (1881), appointed professor of physical chemistry at the Leipzig University (1887), Nobel prize winner (1909).

6. General stores still represent a worthwhile outlet in small, sparsely populated areas in the West, since they are the only outlet for paint in some communities.

7. "Tint" manufacturing is the customary method of manufacturing paint in which the color is added as part of the production, resulting in ready-mixed paints. A "white line house" is a manufacturer who specializes in the production of white paint only. Thus, he eliminates the costs associated with color standardization. Bennett's production of white base and gray base has the advantages of a "white line house."

8. Joseph A. Schumpeter, The Theory of Economic Development. Cambridge, Mass.: Harvard University Press, 1934, pp. 84-86.

Abstract published by special arrangement with The Ohio State University.

SOME MANIFESTATIONS OF THE INFLUENCE OF THE PROVISIONS OF THE FEDERAL INCOME TAX ON GENERALLY ACCEPTED ACCOUNTING PRACTICES

(L. C. Card No. Mic 58-910)

Peter Arthur Firmin, Ph.D.
University of Michigan, 1957

Accountants have complained that the Federal Income Tax exerts undue influence on accounting practice. This study explores selected areas of accounting practice to observe, in a limited number of cases, the character and extent of that influence.

Basic data for this study were obtained from accounting records and federal income tax returns of forty-four corporations for the period 1945-1954. Although these corporations are located in a narrow geographical area, they represent various industries and size classes. Supplementary analyses were made of published financial reports of thirty corporations for selected years between 1913 and 1955. These analyses of observed accounting practices are preceded by comparisons of tax requirements and accounting theory.

Spheres of influence exist because revenue legislation and business accounting have different objectives and embrace dissimilar concepts of revenue and expense measurement. Specific areas of influence include accounting for (1) advances by customers, (2) estimated expense, (3) property taxes, (4) bad debts, (5) inventories, (6) valuation of investments, plant and equipment, and intangible assets, (7) systematic cost expirations, and (8) miscellaneous differences between taxable and accounting net income.

"Advances by customers" (prepaid income) and "estimated expenses" constitute areas of conflict because judicial tests of revenue and expense recognition differ occasionally from accounting criteria. Experience with retroactively repealed Sections 452 and 462 of the Internal Revenue Code of 1954 indicates that sound accounting practice has been disturbed less by income tax influence in the "advances by customers" area than it has in accounting for estimated expense. The practical difficulty of estimating expenses explains the strength of the influence, and the universal nature of the estimated expense makes its omission significant.

Prior to 1954 income tax requirements governing accounting for property taxes did not coincide with accounting theory, but sound accounting practices consistently followed were nevertheless usually permitted.

Although taxpayers are permitted to use the "reserve"

method of accounting for bad debts, the administratively simple but inferior theoretically "direct charge" method has gained much favor as an acceptable accounting practice. Internal Revenue Service administrative procedures have encouraged this tendency.

The Federal Income Tax has contributed to the development of better inventory accounting techniques, and with few exceptions, standard trade practices also constitute acceptable tax practice. The tax requirement that the last-in, first-out method be reflected in the accounts if utilized in the tax return patently has constituted a strong influence on accounting practice.

Accounting "cost" of investments, plant and equipment and intangible assets is usually synonomous with tax "basis" unless the acquisition was by tax-free exchange or some other procedures occasioning special tax treatment. Accounting practice tend to yield a tax requirement in specialized acquisition procedures, but the most important result of income tax influence in this area probably has been better fixed asset accounting. Statutory elections to "expense" certain expenditures have changed accounting practice, but unacceptability for tax purposes of the appraisal and revaluation technique has not prevented its employment.

Percentage depletion is not customarily recorded in the accounts. Until 1954 intangible asset amortization policies seemed independent of tax requirements. Depreciation policies, however, have reflected strong sensitivity to income tax "regulation."

Other inconsequential specific influences exist. More importantly, the Federal Income Tax has provided incentives for the maintenance of adequate records and has emphasized the importance of the matching process. Although variances between taxable income and accounting net income tend to cancel each other in the long run, differences between tax liabilities based on the two concepts do not.

Differences in objectives will continue to cause localized conflict between tax requirements and sound accounting practice. Accounting practice should not yield to tax requirements, but neither should tax provisions necessarily be conformed to accounting practice. 418 pages. $5.35

SUPPLEMENTARY WAGE BENEFITS FOR OUTSIDE SALESMEN

(L. C. Card No. Mic 58-537)

Marvin Hoffman, Ph.D.
The Ohio State University, 1957

The study was undertaken to determine the present status of supplementary wage benefits for outside salesmen and to investigate certain related problems. A substantial growth in such benefits during the past two decades has been well documented. Employers and employees, however, frequently have a poor understanding of the nature, extent, and cost of benefit programs in their own and other firms. Discussions with sales management personnel indicated that there was a need for a comprehensive study of benefits pertaining to outside salesmen only, since these men are often regarded as different from other employees because of their work situation and variable income level.

The information forming the core of the study was obtained from an extensive mail survey of a portion of the membership of the National Sales Executives, Inc. A second mail survey was later conducted among salesmen of three selected companies to learn their attitudes toward the programs affecting them.

The survey indicated that a wide range of benefits was available to outside salesmen. The average program consisted of fourteen or fifteen benefits. These programs typically begin with the legally required items and vacations. Other plans reflecting an emphasis on better personnel practices are then likely to be added. Factors influencing the scope of benefit offerings include the following: type of company, type of product, company size, age of company, and type of compensation plan. Manufacturers and those dealing in industrial goods have the most comprehensive programs. Larger and older companies also offer the most extensive benefits. On the other hand, salesmen paid by commission plans generally have fewer benefits than others.

The growth in popularity of eleven benefits since World War II is noteworthy. The most important of these are the various hospital medical insurances, retirement plans, stock purchase or savings and investment plans, and profit-sharing bonuses.

About one-fourth of the respondents to the sales manager survey supplied information on the cost of supplementary wage benefits. Among this group, total average yearly costs per salesmen ranged from under $200 to $3,700 a year, about 25 per cent of the responding sales forces indicating annual expenditures of $1,000 to $1,500 a salesman. Expressed as a per cent of average annual compensation, the range extended from 2.3 per cent to 48.1 per cent; the median was 15 per cent.

Sales executives believe that their programs are effective in recruiting new salesmen, improving morale, and reducing salesman turnover, although a few basic objections were indicated. Most executives believe that these programs will continue to expand, with emphasis on retirement plans, stock purchase or savings and investment plans, profit-sharing bonuses, and hospital-medical coverage.

Salesmen, themselves, are not fully aware of the programs available to them, beyond certain of the very common plans affecting them most directly. Moreover, they do not recognize the extent of their employers' contributions toward maintaining the benefit programs.

Wage supplements for outside salesmen have developed to the point that most of them are now enjoying the same treatment as any other employee group. With the apparent interest of younger people in benefits, sales management is experiencing the effects of the security trend so prominent in the current American business scene. In fact, many sales management people believe that a continued growth of benefits is necessary to attract college graduates to the selling field. It would seem that more attention must be given to commission-paid salesmen since they generally fare poorly in the matter of fringe benefits. Efforts designed to "merchandise" benefits for salesmen must be implemented and better employer-employee communication must be established in order that these programs may have their maximum effectiveness.

258 pages. $3.35

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INTEGRATION BETWEEN MANUFACTURING AND RETAILING IN SHOES

(L. C. Card No. Mic 58-1349)

Leonard W. Martin, Ph.D.
Columbia University, 1957

Granted that market imperfections invite vertical integration, are stable or dynamic conditions more likely to favor it? Study of integration between shoe manufacturing and retailing, and in apparel and textiles less thoroughly, reveals that stable conditions, based upon staple products, are conducive to vertical integration, while change, through style, is hostile.

About 9% of manufacturers' distributed sales, 1939-1954, were retailed by the same firm manufacturing the shoes. Seventy percent of this portion were men's shoes; the remainder were chiefly comfort and athletic shoes. The men's shoes--for 30 years largely oxfords, of two types, one construction method, and the same few colors and materials--are staples; so are these other types. The percentage of integration accounted for by the 6 biggest participants rose from 60 in 1929 to 80 at present. Integration is more common and firms are bigger in men's than women's apparel. Integration also appeared among the bigger textile firms which produce the more staple, household, items.

Staples foster integration because their stocks involve negligible risks. Those not sold this season can be sold next season. Merchandise, styled seasonally and annually, cannot be so carried; firms mistaking consumer style preferences in the current season experience drastic markdowns. Non-integrated manufacturers avoid this risk by manufacturing "to order"; but integrated firms bear the risk until the goods are sold at retail. Though small flexible firms could produce and retail moderately styled goods, they would miss (limited) economies of size in manufacturing and distribution. Large integrated companies must produce for stock which with big orders provides economies through better planning and standardization of output to achieve the constancy of costs potential in shoe manufacturing. Production of staple merchandise is usually seasonally stable.

Promotion advantages in size, staples, and vertical integration combine to induce such integration. Store displays and local advertising, plus factory-coordinated promotion and merchandising, comprise the promotion benefits available. Correspondence of strong shoe brands with integrated firms is impressive; textile manufactureres with strong brands produce the staples. Big firms producing staple merchandise spend tremendous sums each on advertising, yet their promotion burden--in percent of sales--approximates the industry average.

Weaknesses on small scale retailing, especially excessive variety of merchandise, demonstrated by successful leased departments, manufacturers' franchise plans, and manufacturers' absorption of retail functions, also contribute to forward integration. Bigger integrated firms may provide the retail branch with needed managerial specialization in finance, inventory control, and purchasing. However, large scale retailing may achieve these economies and obtain through buyers' brands something like a quantity discount, mostly remission of manufacturers' distribution costs. Since economies of shoe manufacturing are limited and benefits of stable production from tapered integration somewhat offset by price rises for the less staple items because of increased fluctuations, the chain manufacturers'--and also apparently manufacturers' chains'--prospect for production advantages is slight unless exceptional standardization is attained. Unless there are undiscovered market imperfections or advantages to integration, backward integration is less well explained than the more common forward integration.

Lack of significant differences in profitability casts doubt on private economies, of either size or vertical integration in shoes, as does also the moderate, stable concentration of output and the biggest firms' failure to grow internally. Integration has not eliminated distribution functions, nor reduced their costs. Neither full line nor lengthened product line advantages seem available. Intensity of specialization eases entry and limits advertising advantages. Limited production and promotion benefits of integration and size must, under competition, be forwarded to society. The integrated firm may privately retain a slight brand advantage. Integration in staple shoes is well established; but recent experiments elsewhere face a doubtful future. 374 pages. $4.80

THE WHOLESALE PRODUCE MARKET IN NEW YORK CITY - ITS RELOCATION OR MODERNIZATION TO REDUCE MARKETING COSTS

(L. C. Card No. Mic 58-1299)

Howard Curtis Nielson, Ph.D.
Stanford University, 1958

Many wholesale fruit and vegetable produce terminals in the United States are inefficient because of obsolete facilities. New York City has one of the wrost of these markets.

Perhaps in no other city are the inner workings of terminal distribution more important than in New York City, the country's largest market. New York City reveals the problems of produce distribution in intensified form, with more diversified channels of distribution and greater specialization of function than in other cities. Solutions to New York's problems will aid in establishing general criteria for modernizing or relocating produce markets.

The purpose of this study is to present information on the flow of produce through the various marketing channels of New York City, to examine the costs associated with this movement of produce and to determine the savings which could be made if proper facilities were built at a satisfactory location.

This thesis includes a general description of the marketing channels of distribution with particular emphasis on the portion of the marketing process occurring after the produce arrives at the consuming area. An analysis of the development of facilities is included together with an appraisal of their adequacy, and suggestions for improvement.

The flow of produce is analyzed for the central market, for chain-store warehouses, and for various secondary produce markets. Costs of handling fresh fruits and vegetables are obtained at each stage of the marketing process. These include costs of the following operations: floating produce from New Jersey to Manhattan; transporting produce from the point of unload to the wholesale

dealers' stores and from the stores to the ultimate retailers; unloading, handling within the store and loading produce on buyers' trucks; spoilage and deterioration, delay and congestion; and rental facilities. Comparable costs are obtained for ten chain-store warehouses and eighteen produce dealers with modern facilities in other cities in order to estimate the potential savings of a modern terminal at each of four possible locations.

Findings

New York City marketing channels handled about 165,000 carloads of produce during fiscal 1956, a decline of five percent since 1939. The central whoesale market handled about 111,000 carloads, a decline of about one quarter during the same period, with chain-store warehouses showing compensating gains.

The cost of marketing the 111,000 carloads passing through the central market was over $28,000,000, more than $260 per carload, not including dealers' margins. The largest item was the cost of distributing produce from the central market to the ultimate retailer. Other major costs included transportation from the point of unload to the central market, the handling within the dealers' stores, and the cost of delay due to congestion.

With modern facilities, these marketing costs can be reduced by five to twelve million dollars, depending on the site. These savings would pay for the terminal facility in less than two years at three of the sites.

The major savings are in transportation to the central market. Modern facilities with rail connections and sufficiently wide streets to accomodate large trucks can accomplish an eighty percent reduction in this cost. Other large savings are possible in handling costs and in congestion costs.

It is recommended that the Bronx Terminal Market be enlarged and used as the central market. Convenience to the seller and buyer, and facilities already available weigh heavily in favor of this site. Also, the fact that Bronx Terminal is already city owned and managed would expedite its use to replace the present market. 246 pages. $3.20

ACCELERATED AMORTIZATION AS AN INCENTIVE FOR EXPANSION OF EMERGENCY FACILITIES IN THE DEFENSE ECONOMY

(L. C. Card No. Mic 58-1005)

David Ansell Thomas, Ph.D.
University of Michigan, 1957

The purpose of this study is to analyze the inducement to invest in defense facilities provided by accelerated tax amortization. Emphasis is given in the paper to the administrative application of legislation authorizing use of the inducement from 1950 to the present.

In the background material, events leading up to and supporting the high effective demand for plant assets to be used in producing civilian products at the time Korea was invaded are traced. With a high level of effective civilian demand, investment in defense facilities may entail the sacrifice of alternative civilian prospects. Also included as a part of the background discussion is a consideration, under varying circumstances, of the risk involved in investing in defense facilities.

After a discussion of the benefit bestowed by accelerated tax amortization in each of the World Wars, the interpretation placed on Section 124(a) of the Internal Revenue Code by defense administrators in the present mobilization period is presented. In the application of industry-wide percentages, defense officials have set the percentages so as to call forth the last segment of capacity needed to meet mobilization goals. The objective was to offset the sacrifice of alternative civilian prospects and the risk entailed. Thus, accelerated amortization has not been employed as a measure of the anticipated economic cost expiration attributable to the five-year amortization period.

A measure of the incentive offered by accelerated amortization is presented next. A tax concession and, under certain circumstances, a product price concession provide the inducement. Estimates of the value of the tax concession are made by comparing the tax deduction permitted by accelerated amortization, at various percentages of certification, with both (1) the deduction approved under the optional method of fast depreciation for plant assets acquired after December 31, 1953, and (2) the deduction allowed for normal depreciation. The value of the benefit was found to be modest in each comparison.

Aspects of the produce price concession are discussed next. Negotiation of a defense product price sufficiently high to cover, among other charges, accelerated amortization in conjunction with the tax benefit increases the cost of obtaining defense capacity measurably. If the tax concession alone is attractive enough to call forth certain types of capacity, then the granting of a price concession for the product of such capacity results in a gratuity. However, if both the tax concession and the price concession are necessary to stimulate investment in high-risk facilities, the cost is not excessive unless an equally attractive and less costly alternative exists. And it appears that such an alternative is not available.

As an integral part of the discussion of the inducement, the effect of accelerated amortization on investment payback is presented. Computations are made to demonstrate (1) that the tax concession accelerates cost recovery and (2) that a combination of the tax concession and the price concession accelerates cost recovery even more. The fast pay-out tends to reduce risk hazards and uncertainty.

It is concluded that until an alternative method with the promise of equal potency at lower cost and with as little threat to the future well-being of our free enterprise economy is discovered, accelerated amortization will continue to be an expansion incentive of great usefulness during periods of international tension. 191 pages. $2.50

ACCOUNTING PROBLEMS OF THE TENNESSEE VALLEY AUTHORITY

(L. C. Card No. Mic 58-1012)

Vern Hargrave Vincent, Ph.D.
University of Michigan, 1957

This research was undertaken in order to locate and analyze major problems involving accounting which have confronted officials of the Tennessee Valley Authority. It required the study of literature concerning both accounting and TVA; and it was found necessary to utilize information secured directly from TVA sources. The critical areas for examination were found in the problems of common-cost allocation, the real cost of TVA power, and the application of accounting theory to specific situations.

These problem areas were analyzed in turn after the presentation of material important to an understanding of TVA: the historical background of the organization and a summary of events significant in its development during the first twenty-two years.

With respect to the problem of cost allocation it was found that the method developed by TVA is accepted currently as the most reasonable approach by other federal-government agencies responsible for stream planning; that the TVA application of the method receives now only minor criticism largely confined to the measuring of benefits to navigation; that allocation is inherently indeterminate, there being no "correct" solution which can be formulated on the basis of accounting or any other discipline; that the indeterminateness found in the problem of common-cost allocation is typical of cost accounting generally, differing only in degree at TVA; that, as a result, in business reporting only an answer which is "reasonable" can be found usually for the total cost or average total cost of a unit of product or service; that allocation is not relevant to business decisions generally; and that if product pricing is to depend on allocations, despite the inherent arbitrariness (as appears to be true in some federal multiple-purpose water control agencies) the allocation should be determined to the fullest extent possible in the basic law.

In the area of cost determination it was found that converting TVA's recorded and reported costs to actual or real costs required numerous adjustments. These adjustments reflected not an inadequacy of TVA records but limitations inherent in the record-keeping process, limitations created primarily by the need for objectivity in recording. Major implicit costs of power, that is, real costs not actually entered in the books because of not having been incurred by TVA itself, were found to be the annual cost of capital and federal taxes, the former being as a rule implicit to private firms in large measure and the latter being explicit to firms generally but implicit to TVA. Minor implicit costs were found to be construction interest, workmen's compensation cost, and unemployment compensation cost. Recorded costs were not adjusted for changes in the general price level from 1933 to 1955. For purposes of cost analysis TVA's recorded annual depreciation on power assets was converted by formula to a modified compound-interest basis.

The inference can reasonably be drawn from the cost analysis that TVA power revenues have covered the real costs of power including imputed federal taxes and capital cost at a rate somewhat above 3 percent. It is not clear whether this rate actually covers the cost of capital dedicated to TVA by the United States government; the rate exceeds the government cost of money but not the opportunity cost of capital in the electric utility industry.

The TVA treatment of the questions of accounting theory which were examined in detail, as well as the handling of a allocation and cost problems, appears to justify the statement that the accounting reports of TVA have been generally well prepared and that they have been misleading only to the extent determined by the inherent limitations of accounting. 471 pages. $6.00

ECONOMICS, FINANCE

THE LEGAL INVESTMENTS OF CERTAIN CLASSES OF FINANCIAL INSTITUTIONS

(Publication No. 25,441)

Edwin Eugene Grossnickle, Ph.D.
The Ohio State University, 1952

For many years investors have associated strength with the securities classified as legal investments. The classification merited the brand of superior quality and presented opportunities to reduce the cost of funded debt. The "legals" have been regarded as prime investments, safe as commitments for institutions mobilizing the savings of broad groups of the population.

A legal investment is an investment ascertained by the regulating authorities to be in conformity with such standards of quality that it is selected for inclusion in a list approved for such commitments, or it is an investment of such quality that it could be included in the portfolio of a prudent investor responsible for the investment of resources subject to legal investment regulations. The dissertation is an inquiry into the nature of legal investments. What is the kind of regulation that is specified through the statutes? What appear to be the purposes underlying the statutory controls? How do the standards compare from state to state and for different classes of regulated institutions? Can the regulating authorities employ such skill in prescribing the legal lists that the lists will be both broad enough to assure quality and at the same time screen out weaknesses? What is the character of administrative policy? What is revealed in the investment performance of legal list securities over an extended period covering fluctuations in cyclical conditions?

Broad economic importance is involved, for an extensive group of people, agencies, and institutions are subject to the legal investment regulations. The largest of the regulated institutions are the savings banks, trust companies, life insurance companies, and savings and loan associations. The estimated savings for the United States on December 31, 1950, was $176 billion.[1] Approximately $110 billion of this amount was deposited with the primary classes of financial institutions of this study. Life insurance companies had $54 billion, trust companies $22 billion, mutual savings banks $20 billion, and savings and loan associations $14 billion. The balance of the $176 billion consisted of $50 billion in United States savings bonds,

$13 billion in time deposits in commercial banks, and $3 billion in postal savings.

In the third of a century from 1916 to 1950, the life insurance companies, savings banks, and savings and loan associations have become very important in the credit structure of the nation. During that period the assets of these institutions have increased their holdings of the net long-term private debt in the United States from 26 per cent to 83 per cent.[2] If the assets of trust companies were included, the figure would be larger than 83 per cent.

As regulators, the states recognize the protective function as a statutory necessity to assure full performance of the expressed or implied responsibilities associated with the investment of resources subject to legal investment regulation. The regulations for savings banks have been pace-setting in many states for the other primary institutions.

Two rules or methods have been employed as regulating media. Under the "legal list rule" the approved investments are prescribed by the states, usually in lists of securities or specified classes of loans issued from time to time by the state supervisors or regulating agencies. With the "prudent man rule" the institution is at liberty to choose its investments as long as it exercises a quality of judgment in accord with that employed by a prudent man under similar circumstances.

In order to survey the statutory controls of institutional investments a selection was made of the most important states. This selection was based both upon the number of institutions of a class in a state and upon the high standards and clearly definitive quality of the statutes. From eight to eleven states were analyzed and compared for each of the four major classes of financial institutions studied. The sources of statutory detail for savings banks, trust companies, and life insurance companies was Moody's Governments and Municipals Manual--1951. The sources for state-chartered savings and loan associations were the office file data compiled by the United States Savings and Loan League under the titles, Powers Granted to Savings and Loan Associations to Invest Surplus Funds and Approved Real Estate Loans. The source for statutory data for federal savings and loan associations was the Home Loan Bank Board release entitled, Rules and Regulations for the Federal Savings and Loan System. The statutes were compared in terms both of type of issuer, that is, governmental, corporate, or other, and also in terms of a particular kind of security or form of credit.

It appears that the primary motive of the writers of the statutes and of the regulating agencies has been to maintain the safety of the invested institutional assets. In the statutes, income is utilized as an important criterion of eligibility, but apparently is secondary to safety in the administrative planning of the regulators.

A comparison of the statutes reveals that the regulations in some states are designed to favor the businesses of those states. The statutory prescriptions do not fall within a distinct pattern, either within one institutional class or between institutional classes. However, in the cases of savings banks, trust companies, and life insurance companies, it is generally true that United States government bonds can be purchased without limit. Most states permit these institutions to purchase and to hold the securities issued by the various states and the local political subdivisions, the International Bank for Reconstruction, and railroad and utility bonds. The purchases are limited under prescribed conditions of eligibility of a wide range. For savings and loan associations most of the states approve investing in the stock and obligations of the Federal Home Loan Banks, the Federal Savings and Loan Insurance Corporation, and in the shares of other savings and loan associations. Primary attention is given, however, to the making of real estate loans. In this class of institutions, also, the conditions of eligibility are not uniform.

The regulators appear to be still seeking after the goal of the planned conservation of invested institutional resources. As stated above, the regulators have been divided in their methods. One group favors prescribing investments and the other group favors the defining of responsibility. There may be evidence of arbitrariness on the part of the regulators under the "legal list" method. Are the wide differences in such provisions as times-interest-earned requirements, default-free periods, portfolio limits of eligible groups of securities, approval for investing in Canadian securities, and permission to invest in common stocks to be construed as normal differences in the regulators' interpretations of protective responsibilities? Or, on the other hand, are the differences evidence of inconsistencies in standards? Can the differences in investment standards be attributed to the variations in experience, qualifications, and freedom from political influence of the state administrators and of the writers of the statutues? Are these problems of such weight that the lodging of more investment discretion with the institutions merits broader consideration?

In this study an effort was made to evaluate the investment performance of savings banks, one of the most conservative of the institutional groups, by observing the market performance of the securities in the New York savings bank legal list for 1928. The survey period was from 1928 through 1950. The legal lists for this period were obtained from the Superintendent of Banking in New York. The securities were traced through the annual lists to ascertain the year in which any of the particular securities were removed. An investigation was then made in Moody's Manuals to determine whether the removal had its source in the maturing, refunding, or calling of the security. If these were not the reasons for removal from the list, it was concluded that the removal was due to the superintendent's finding the security non-legal. No treatment was attempted for the three hundred sixty-eight issuers of securities for municipalities and sundry governmental units because the legal lists supplied only the names of issuers and did not specifically identify securities.

During the period closing in 1950, five hundred six of the five hundred twenty-three corporate securities in the list were removed. In the case of railroad bonds, 32.4 per cent were removed by the issuer by calling, refunding, or maturing, and 63.6 per cent were classified by the Superintendent of Banking as non-legal. This situation did not prevail with the electric and gas company bonds, for 75.9 per cent were removed by the issuer and 21.4 per cent classified non-legal. Most of the railroad bonds which became non-legal would have received such a reclassification status in 1932 if the Superintendent of Banking had not suspended some of the legality requirements. Under these circumstances 22.3 per cent became non-legal in 1932 and 62.9 per cent in 1938, when the suspension was lifted.

For this study the statutory tests for legality were not

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made year by year to check the action of the New York Superintendent of Banking in his retention of reclassification of securities in the legal list. However, prices were surveyed as an aspect of performance, primarily to check the success of the legal list system in maintaining the safety of the invested deposits. To conduct the survey it was assumed that all of the corporate securities in the legal list for 1928 were purchased in that year. In addition it was assumed that if a substantial number of securities reflected a price pattern in markedly lower deviations from the price pattern of a separate group of high-grade securities, the result would be tantamount to a failure to maintain safety.

In the case of railroad bonds it appears that safety was not maintained, for nearly two-thirds of the bonds turned non-legal early in the test period. Moreover, for the non-legal bonds there was a much lower price pattern, both in comparison with a mixed group of legal bonds and bonds turned non legal, as well as with an index group of ten Dow-Jones high-grade railraod bonds. The greatest potential loss in any year would have derived from the sale at a value 33.95 per cent lower than the price pattern of ten Dow-Jones high-grade railroad bonds in this year. In contrast, using these same standards, the record of the utility bonds was one of safety. The price pattern for the period averaged higher for a group of utility bonds that became non-legal and was higher in fifteen of the twenty-two years of the survey period.

It is plausible to inquire whether the poor showing of the non-legal railroad group and the favorable price pattern of the non-legal utility group provide partial substance for concluding that the hindsight methods used to test legality status cannot be counted upon to bring consistent results and maintain safety for all classes of qualified securities through periods of severe testing. Or is it to be expected that management will not be able to choose qualified securities except from among those in a prescribed legal list but nevertheless will be capable of such foresight in selecting and disposing of the weakest holdings in the portfolio when it may become necessary to do so that the relative safety of the portfolio will be maintained?

Where law and regulation are involved, it is customary to evaluate the nature and methods of the administration of the law. In this study the evaluation of this administration is based upon information gathered by means of a questionnaire sent to the state administrators of the forty-eight states. The viewpoints of the administered institutions were obtained from the replies to a questionnaire sent to the savings bankers of New York State. In addition, a sampling was made of the annual reports of the state administrators of the four classes of institutions of this study.

In most states the state banking department supervises the savings banks, trust companies, and savings and loan associations. Life insurance companies are usually regulated by a separate commissioner or superintendent. Also, in most states institutional investors must be able to show that their portfolios conform to the statutes. State administrators generally agree that this amounts substantially to self-administration.

Under the legal list system and in the event a portfolio must be adjusted to meet legal standards, it is usually the case that a reasonable period is permitted to complete the adjustment. However, a substantial minority permit the regulatory officer to determine the length of the period. The administrative follow-through in such cases is frequently by the regulatory officer rather than the examiner.

An inspection was made of some of the annual reports issued by state administrators. The publication of annual reports, for the most part, has been made to complete a legislative requirement. Most of the reports are statistical and may be of doubtful value. Some states are turning to concise summaries or to no report at all for reasons both of economy and, apparently, usefulness. Only in rare cases are treatments given of primary problems and policies. The reader of the annual reports may be inclined to the opinion that unless the reports supply adequate presentation or primary problems and policies the legislatures and governors will not be informed on the real status of the institutions reported upon. Under these circumstances the spirit underlying the requirement of the annual reports will not have been fulfilled.

On the basis of a sampling of the attitudes of officers of savings banks in New York State, an effort was made to ascertain the character of administrative policy from the viewpoint of the administered. A questionnaire was sent to seventy-nine of the one hundred thirty-eight savings banks of New York listed in Rand McNally's Bankers Directory, Final 1950 Edition. Two savings banks in each city were chosen, the largest and the smallest, according to reported total assets. Replies were received from fifty-three, or 67 per cent. The management of these banks are subject to the "legal list system" in thier investment of bank resources. They were generally of the opinion that their close conformity to the investment procedures and legal list for New York savings banks had the practical effect of self-administration of their investment activities. The bankers lacked experience concerning concrete cases of failure to conform to statutory regulations. Most bankers thought that too many securities of good quality were omitted from the legal list. Considerable support was given for the viewpoint that the investment return would be larger under the "prudent man system," but there was less assurance that the investment principals would be just as dollar-safe. Much indecision was evident on the question of whether the legal list was sufficiently broad to care for the volume of funds to be invested.

During the past decade the primary financial institutions have been the recipients of a greatly expanded volume of savings and resources. To fulfill the greater demand for investments there have been two major sources of increased supply. One source has been the debt instruments of the various governmental units from the local to the federal level. These instruments were issued in very large amounts because the war and post-war economies operated upon greatly expanded spending bases and, in time, upon a price structure characterized by the diminishing value of the dollar. The second source was common stocks. The supply in this instance was made greater by the relaxing of restrictions against their purchase.

Along with the broadening of the investment supply, a significant change has been the substantial movement to make less rigid the investment prescriptions of financial institutions. Different forms and degrees of relaxation have appeared. In many cases savings bank legal lists have been broadened. Leeway provisions have been provided for insurance companies in some states. Investment boards have been substituted for legal lists. Particularly in trust regulation, a preponderant swing has occurred during the past decade to the "prudent man system." It

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appears that in the movement away from rigidity at the present time we are in the midst of change rather than at the close of a period. 308 pages. $3.95. Mic 58-4804

1. Statistical Abstract of the United States--1951, United States Department of Commerce, Seventy-second edition, p. 400.

2. Bell, Haughton, and Fraine, Harold G., "Legal Framework, Trends and Developments in Investment Practices of Life Insurance Companies," Law and Contemporary Problems, 17 (Winter, 1952), p. 53.

Abstract published by special arrangement with The Ohio State University.

INFLATION IN FRANCE, 1939-1952

(L. C. Card No. Mic 58-1351)

Seymour Harold Miller, Ph.D.
Columbia University, 1957

Between 1939 and 1952 the French wholesale and retail price levels increased roughly 2500 per cent. This inflation was more severe than that of any other Western European nation except Italy during the same period or than that of France between 1914 and 1926.

The rise in French prices during World War II had two principal causes. One of these was a sharp drop in both industrial and agricultural production due to the blockade, war damage, inadequate maintenance of equipment, and other consequences of the war. The other was the fact that during four years of military occupation Germany extorted from France more than one-fourth of the latter's gross national product through occupation costs and an uncleared clearing agreement. As a result, food consumption by the nonfarm population was cut by roughly one-half and supplies of other consumer goods were even scarcer. The money supply increased several-fold, mainly because the central bank had to finance most of the occupation costs, but this was partly offset by a decline in the velocity of circulation. Although price controls and rationing were resorted to, these were only partially effective.

During the early postwar years, the principal inflationary force was probably a great increase in consumer spending resulting from the desires to return to more normal living standards and to get rid of idle money, which was depreciating in value. This was reflected in a sharp rise in velocity. Two other major inflationary forces were the large government deficits and a great increase in bank credit, both of which added to the money supply. In addition, shortages of consumer goods, particularly food, remained serious until the end of 1948, and the system of rationing and price controls gradually broke down.

The inflation came to a pause during 1949 and early 1950 as a result of good harvests, lower world prices and some relaxation of demand. However, the Korean War set off another wave of price rises, which was longer and more severe in France than in most other countries. By 1952, the inflationary pressures had spent themselves.

Although the wartime inflation was largely unavoidable, that of the postwar period was due in considerable part to policy errors. Perhaps the worst of these were the failures to sponge off part of the enormous idle balances that had accumulated during the war and to curb effectively the extension of bank credit after the war. The inflationary implications of a swollen money supply were not widely recognized. Government deficits and the breakdown of rationing and price control enforcement were also partly to blame, although under the circumstances these were almost inevitable. A large postwar investment program contributed to the inflationary pressures, too, but probably not to the extent that some critics have charged. On the other hand, wages were not a primary cause, since they lagged far behind prices, and the wage-earners' share of national income dropped. A large postwar import surplus, financed mainly by foreign loans and grants, helped to offset the inadequacies of domestic production and hence the rise in prices; at the same time, the inflation aggravated a serious balance of payments problems by making exports more costly.

France's inflation resulted partly from the failure to understand some of the economic problems involved, but also to an important extent from political instability and social divisions which prevented the government from taking the necessary steps to hold prices in check.

489 pages. $6.25

AN EVALUATION OF ASSESSMENT RATIO STUDIES IN SELECTED STATES

(L. C. Card No. Mic 58-1093)

William Monroe Shenkel, Ph.D.
University of Washington, 1957

Assessment ratios, describing percentage relationships of property tax assessments to sales or other valuation standards, have been given greater attention in state and local finance from 1940 to the present time. Taxpayer groups, tax officials and other authorities have undertaken numerous assessment ratio studies in this period. The statistical treatment of assessment ratios, variously presented, usually purports to describe the precise level of assessments and, in most instances, the comparative uniformity of assessments.

The fiscal effects of assessment ratio application in state and local finance and the extensive use which is made of assessment ratio studies by taxpayer groups recommends a critical review of assessment ratio methodology. Therefore the present analysis includes a discussion of the purpose of assessment ratio studies and an evaluation of assessment ratio techniques in twelve selected states. A comparison is presented between earlier assessment ratio methods and current assessment ratio practices in certain states. From data relating to the surveyed states several recommendations are offered for the improvement of assessment ratio studies.

Assessment ratio research currently undertaken in the states of California, West Virginia, New York and Wisconsin rely mainly upon appraisal standards with which to measure assessed valuations. The evidence in these states and other areas indicates the serious inadequacies in the use of appraisal-assessment ratio analysis for tax purposes. The subjective nature of opinion evidence, the selection of biased samples, an inadequate number of statistical observations and the restricted objective of

assessment-appraisal ratios are the more important limitations of utilizing the appraisal standard.

Property tax studies in the states of Kansas, Illinois, Kentucky, Iowa, Minnesota, Nebraska, Pennsylvania and Idaho, publicly and privately sponsored, indicate the use of questionable methods of describing assessed values by comparison to sales values. The most common violations of what purports to be objective research relate to questionable sample selection, the nondisclosure of relevant data, arbitrary manipulation of assessment ratios and the concealment of assessment variations.

The examination of assessment ratio studies of the various states demonstrates the superiority of the sales standard as a means of measuring assessment relationships. In addition, proper procedures for the objective measurement of assessed values require (1) tests of sample reliability, (2) dependence upon the arithmetic mean as a measure of central tendency, accompanied by alternative statistical averages, and (3) tests of assessment dispersion. The greatest advantage of assessment-sales ratio analysis concerns the determination of assessment uniformity between and among the various sample stratifications. The disclosure of the existing differentiation in assessment ratio studies is a necessary requirement in assessment-sales ratio analysis. 459 pages. $5.85

COMMON STOCK FINANCING IN 1955

(L. C. Card No. Mic 58-999)

Harold William Stevenson, Ph.D.
University of Michigan, 1957

Corporations employ various methods and devices in offering new shares of common stock to investors, and it is of great importance for the growth of our economy that these efforts by successful. This study relates the variety of methods used in privileged subscriptions and public offerings of common stocks during 1955 to company and environmental situations. It also contrasts these methods in terms of costs and results. The desired goal would be to determine the best and most efficient methods for general situations, but circumstances were found not to fall into nice patterns so a considerable number of combinations and arrangements are described to demonstrate the effectiveness of alternatives.

The 1955 sample includes 116 common stock offerings each with proceeds in excess of $1.0 million, made by 58 utility and 58 industrial companies. These offerings total nearly $1.5 billion, representing approximately 78% of the year's total common stock offerings, and include 71 privileged subscriptions and 45 public offerings which are analyzed in detail on the basis of information drawn from prospectus material and questionnaires designed to elicit motivation data from management. These data are supplemented by opinions based on correspondence with corporation treasurers, interviews with investment bankers, and on published tabulations of offering characteristics. Discussion of factors which influence the selection of offering methods includes consideration of preemptive rights of shareholders, stockholder relations, regulatory environment, investment banker influence, and cost of issue. The treatment of privileged subscription offerings centers on the arrangements made to perform the functions referred to as bookkeeping, persuasion, and assurance. Specifically, these arrangements involve the use of such techniques as underpricing, over-subscription privileges, dealer compensation, standby underwritings, and employee subscriptions. Discussion of public offerings centers upon arrangements for performing the functions necessary to this type of equity financing and upon the observable factors conducive to a successful offering.

The volume of common stock financing is found to be closely associated with the level of stock market prices both as to dollars and number of offerings. New offerings of stock, while increasing in recent years, still rank far below retained earnings as a source of new ownership funds. Underwritten privileged offerings and underwritten public offerings are the predominant offering methods, and neither method appears to be supplanting the other. The risk-taking and distribution functions performed by investment bankers dominated the problems of equity capital-raising, thus justifying their use in one way or another. The various offering techniques used to effect the relatively large volume of equity financing in 1955 defy strict classification in terms of company or environmental conditions. However, possibilities and limitations of various methods of raising equity capital are presented, and the detailed analysis of 1955 offerings is designed to indicate how and in what direction a company may turn in its search for an effective solution of its equity capital raising problem.

289 pages. $3.75

A THEORETICAL ANALYSIS OF EXCISE TAX INCIDENCE

(L. C. Card No. Mic 58-1307)

Paul John Wells, Ph.D.
Stanford University, 1958

A theory of the incidence of the burdens and benefits of an excise tax in a perfectly competitive economy is developed. So that a diagramatic analysis can be made, the economy is assumed to consist of two people, two factors of production, and two commodities. The main conclusions derived for such an economy are: (a) that an excise tax imposes both a burden--an aspect of excise taxes long recognized and much discussed in the literature--and a benefit--an aspect of excise taxes that has been little discussed in the literature; and (b) that these burdens and benefits fall on individuals as buyers and sellers of goods and services, and the degree to which the burdens and benefits of an excise tax spread out from one individual or group of individuals to another individual or group of individuals depends upon the preference functions of all individuals, the tax expenditure policy of the government, and the nature of the production functions of the commodities produced.

A theory of excise tax incidence for an imperfectly competitive economy is developed next. In order to take into account the existence of monopoly power, it is necessary to abandon the classical general equilibrium model previously used, and carry on the analysis with an aggregative Keynesian-type model. Toward this end a five-sector model of the economy is developed. Although no

explicit use of the perfectly competitive model is made, the results there obtained--especially with respect to the effect changes in relative prices and the composition of output have on the distribution of income--are explicitly made use of. In fact, many of the more interesting and important results obtained for an imperfectly competitive economy would not have been possible in the absence of the perfectly competitive economy. The major conclusion which emerges from the analysis of an imperfectly competitive economy is that the distribution of the tax burden depends mainly upon the distribution of monopoly power, with changes in relative prices, dut to other reasons, exerting a less important influence. 62 pages. $2.00

ECONOMICS, THEORY

A STUDY IN PRODUCTION PLANNING

(L. C. Card No. Mic 58-1153)

Einar Hardin, Ph.D.
University of Minnesota, 1957

The purpose of the study is to define characteristics of some important production-planning problems not represented by existing mathematical planning models and to help develop models and computational procedures suitable for it. The planning of weekly production in a powerpress department of a metalworking company is studied. Direct observation, interviews, and study of company records supply nonnumerical information on technology, primary-resource availabilities, final-product demands, and optimizing objective.

A "literary" description and analysis of the nonnumerical information, with major emphasis on definition of activities, determination of the form of input-output relationships, and factors restricting the choice of production plan, is given in Chapter II. Conversion, operating, and transportation activities are identified. Resource use in operating activities is considered proportional to activity levels (outputs). Resource use in any conversion activity is zero, when output of the corresponding operating activity is zero, and is positive and independent of operating-activity output, if the latter is positive. Resource use in transportation activities depends on both occurrence and volume of transportation. Resource requirements are then nonproportional to output and show distinct indivisibilities. Presses differ in capabilities and resource use. Alternative methods of production exist. Intermediate products are numerous. Primary materials arrive, and final outputs are due, at various dates during the week. The planning problem is regarded as minimizing total cost subject to numerous constraints.

In a mathematical reformulation presented in Chapter III, the problem consists in minimizing a linear cost function subject to dated constraints on transportation flows, on balances of primary materials, intermediate products, and final products, and on machine and tool availabilities. There are side conditions requiring certain variables to be zero or unity or to be either zero or equal to the value of some other variable, depending in both cases on further variables. Sources of difficulty in applying the model, chiefly the multiplicity of constraints and the indivisibilities, are discussed. Simplications are found imperative. Chapter IV shows how removal of indivisibilities can lead to a multiperiod linear-programming problem.

Chapter V analyzes indivisibility problems relating to conversion activities and expresses the simplified planning problems as extensions of the conventional traveling-salesman problem. Several types of single-path problems are identified. The number of admissible paths and the distribution of path lengths are discussed, with emphasis on establishment of lower bounds for lengths of shortest paths. Procedures for finding short and shortest single closed paths in the case of symmetric distance matrices, including one procedure presented by Dantzig, Fulkerson, and Johnson, are analyzed. Lengths of shortest paths obtained by their use on random-number matrices are compared; it is suggested that some approximate procedures may not be greatly inferior to exact procedures. Problems of shortest open paths, of nonsymmetric distance matrices, and of special distance and sequence constraints are studied, and the Dantzig-Fulkerson-Johnson procedure is modified to fit these single-path problems.

Two groups of multiple-path problems are also stated and studied in Chapter V. Formally they involve closed, mutually exclusive paths, where each point is included in one path or where one point from each of certain subsets is included. Required modifications of the Dantzig-Fulkerson-Johnson procedure are described. Problems involving paths having two or more points in common, open paths, or "salesmen" with different distance matrices can be transformed into the above types of problems. Some production-planning problems involving two or more identical or different machines can then be solved through traveling-salesmen methods. There remain some unresolved problems, which are briefly discussed.

285 pages. $3.70

EDUCATION, GENERAL

BUSINESS TEACHERS' FIRST YEAR OF EXPERIENCE: SELECTED CASE STUDIES

(L. C. Card No. Mic 58-889)

Darrell Videll Burras, Ph.D.
University of Michigan, 1957

This investigation was a case study of the initial teaching experiences of twenty-one beginning business teachers in order to discover the complex of factors that affected the adjustment and professional growth of beginning teachers week by week through their first year of teaching. The data were obtained:

1. From twenty-one beginning business teachers who recorded each week the high lights of the week, the difficulties encountered, the morale testing experiences, and the moments of elation.
2. From these twenty-one beginning business teachers also in weekly group meetings in which they talked over the experiences of the week and exchanged thinking about how the problems encountered during the week might best have been met.
3. From personal interviews with the twenty-one beginning business teachers late in the year's experience.
4. From visits to the schools to observe the teachers at work.
5. From the principals of the twenty-one beginning business teachers in personal interviews.
6. And from information in the files at the colleges from which the twenty-one beginning business teachers had graduated.

The report contains a summary of previous studies having to do with the adjustment and problems of beginning teachers, 190 pages of case reports, a chapter on analysis of the teaching difficulties, and a list of nine conclusions and six recommendations.

Conclusions

1. The first few weeks are a period of crushing adjustments, anxieties, worries, and uncertainities.
2. The teachers who are the least adequately prepared and have the greatest need for good supervision are likely to be hired into teaching positions where they are least likely to receive good supervision - serving what amounts to a year of unsupervised internship.
3. The insecurity of beginning teachers is intensified when they are given assignments for which they are not prepared.
4. The peak of insecurity is associated with the first marking period.
5. Adjustment to the teaching situation is helped by identifying oneself with, and living in, the community.
6. Teacher growth in competencies may be imparied by trial and error methods of solving problems.
7. Some administrators in small schools expect a rapid teacher-turnover and consider their schools to be training stations for beginning teachers, without having the experience and resources necessary to give the supervision that such a role calls for.
8. Teachers who make a great deal of professional growth are more sensitive to their teaching problems, make greater efforts to solve these problems, have a stronger interest in teaching, and receive more helpful supervision than teachers who make little professional growth.
9. The personnel data on file at teacher-training schools is inadequate and incomplete in many respects, and many of the files contain no information that would predict certain strengths and weaknesses. 273 pages. $3.55

AN EVALUATIVE STUDY OF AN EXTRA-MURAL SCHOOL CAMPING PROGRAM FOR ADOLESCENT BOYS IDENTIFIED AS POTENTIAL SCHOOL LEAVERS

(L. C. Card No. Mic 58-1175)

Roy Cole, Ed.D.
Wayne State University, 1957

Supervisor: Dr. J. Wilmer Menge

This study was an evaluation of a work-learn camp at Mill Lake, Chelsea, Michigan, sponsored by the Dearborn Public Schools in 1951-52. The two main aspects of the problem under investigation were (1) to determine whether a work-learn camp for potential drop outs had more holding power than the regular high school program for a comparison group of potential drop outs who remained in school, and (2) to determine whether the camp program helped campers to improve in their home, school and social adjustment upon their return. The plan of the study included identification and selection of three groups of boys. Two of these groups were potential drop outs and one group was judged to be well adjusted to school. One of the two groups of potential drop outs attended a work-learn camp for more than half a school year while the other two groups continued in the regular school program.

This study evaluated the complete camp program with particular emphasis on a follow-up study of campers and non-campers made in 1953.

Evidence from the follow-up study indicated that the camp experience with a change of setting from the normal school routine produced socially desirable changes in the camper's attitudes and behavior. Their attitudes towards

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adults, teachers, counselors and others become more friendly and cooperative. They showed improved attitudes towards school. The evidence also indicated improved vocational and personal skills, better health habits and eating habits.

The findings show there were distinct differences between the group of boys who went to camp and the other group of potential drop outs that did not go, although given the opportunity. The latter group was found to have a wider range of interests in out of school activities than the campers. The evidence showed further that over a period of years, the quality of relationship with peers and adults had been significantly better for the "comparison group" of potential drop-outs than for the camping group. A third major difference was the lower level of aspiration of the campers. The comparison group, therefore, cannot be considered as an equated control group. Certain of the differences referred to here were not identified until after the program was well underway.

The evidence shows distinguishable differences between boys who were considered well adjusted and those who were not. The well adjusted boys were found to have higher school motivation. They participated more in school activities and showed a greater degree of acceptance of the value of school for their future plans. One of the major differences between the well adjusted boy and the potential drop-out was found in their attitudes toward society, authority and social relationships, generally. The well adjusted group was far ahead of the camper and comparison group in school achievement and they were the only group that participated in school activities.

Thirty-two percent of the campers returned to school to graduate. Sixty percent of the non-campers or comparison group graduated and ninety-seven percent of the well adjusted group completed high school.

There is need to explore further certain aspects of camp life, such as the relationship between camper and camp counselor, which may have value in the normal school setting. There is need to explore the value of school activities other than the conventional curriculum that may be of great interest to some of these boys. There is need for continuing study of the extra-curricular program with the view of increasing student interest and participation. This might call for dropping those activities that are of relatively little interest to students and initiating new activities that would have appeal for many students not now taking part in any school sponsored program outside the classroom.

There are significant implications here for the development of stop gap programs designed for unemployed youth in our country in event of a serious recession or depression. 124 pages. $2.00

JEWISH PHILOSOPHY OF EDUCATION

(L. C. Card No. Mic 58-1188)

Rabbi Leo Y. Goldman, Ed.D.
Wayne State University, 1957

Supervisor: Dr. Robert Rothman

The period covered in this dissertation is more than 3,000 years from 1400 B.C. to the present time. The author will attempt to show the origins, growth and philosophy of Jewish education in this long period of history, from its inception with the creation of the Jews as a nation of monotheists. The question of monotheism is important since the foundation of Jewish education rests strongly upon a religious premise.

These 30 centuries will be divided into four historical periods. 1) From 1400 B.C. to 586 B.C., the period of the First Jewish Commonwealth. 2) The period of Babylonian Exile, from 586 B.C. to 538 B.C. and the subsequent Second Commonwealth down to the fall of Jerusalem in 70 B.C. 3) The period of wandering and exile throughout Europe from 70 B.C. until the beginning of the 19th Century A.D. when enlightenment came into Europe. 4) From the early 19th Century to the present time, with all the complications of two world wars, extended immigration of Jews to the United States and Palestine; the birth of a great Jewish community in the United States and the establishment of the State of Israel.

In each of these sections, the author shows the historical and cultural conditions which have influenced the philosophy of Jewish education, and he discusses the curricula and educational structure of each period. In addition he will develop the philosophy of education, which, with some exceptions, remained almost constant from the earliest days of Moses, the Lawgiver and first educator, to the present time. Each part is presented chronologically and geographically, with due consideration in each case for the type of community from which sprang ideas and in which ideas were developed. The economic situation in each case is discussed relative to its effect upon education and the social factors involved in each era are also explained in the light of education.

Especially, the author stresses the unique concept of Jewish education as a system of education meant to be life-long and in a sense a way of life. Since Jewish education was based upon the Law and the observance of that Law, which includes all phases of human behavior and conduct, it became therefore a rule of life to the Jew, not merely a training for limited functions such as is received in secular schools for a trade, profession or social adjusment. It was, in short, a complete philosophy of life.

In the concluding chapter, the author deals very fully with the question of Jewish education in the United States and the position of this country as one of the two main bases of Jewry today. He shows how in the United States the Jew need not be forced to make a definite and irrevocable choice between assimilation and segregation since the Jew is a member of a minority among many minorities and can enjoy his rights as an American as well as a Jew without forced assimilation.

While the author throughout has given his consistent point of view, he has not attempted to maintain his own philosophical frame of reference against those of others with conflicting ideas. He has tried to discuss this broad question as objectively as possible and to give due consideration to differing viewpoints on all questions.
304 pages. $3.90

THE USE OF COMMUNITY RESOURCES AS A METHOD IN THE TEACHING OF BIOLOGY AT AT THE EAST TEXAS BAPTIST COLLEGE

(L. C. Card No. Mic 58-592)

Shirley Wolz Handler, Ph.D.
The University of Oklahoma, 1958

Major Professors: Ellsworth Collings and Henry D. Rinsland

Scientists and educators are in need of more science students for research and for teaching at all levels. Students apparently lose interest in science which they had manifested as children. How may students be attracted and kept interested? The answer to the question would seem to be in the method of teaching. Not enough research on methods evaluated by valid tests has been done.

Since biology is the study of life, the method best suited for the study of biology would seem to involve living organisms and the out-of-doors. In the experiment this method was called the community resource method. The problem of this study was:

1. Can the biological curriculum be integrated with community resources?
2. If so, to what extent, with what effect, and under what conditions?

The investigation was limited to the year 1953-1954 and to instruction offered by the writer at East Texas Baptist College. Two methods of instruction, the lecture method and the community resource method, were alternated with two sections meeting at different times.

The course was divided into ten units, chosen to satisfy the course description and the aims of the course, which were followed by twelve subject-matter and ten attitude tests made by the instructor. Records were kept of outside readings, collections, and comments on the course.

Two subject-matter and two attitude tests when subjected to the "t" test and four attitude tests when subjected to the chi-square test revealed significant differences at or beyond the .05 level of confidence.

The results led to the following conclusions:

1. In the teaching of biology many methods are useful, and no one method should be used to the exclusion of others. Students develop different attitudes toward biology as these methods are used and consequently are attracted by the different fields of biology.
2. The lecture method is still a very necessary part of a biology course. Some units of biology including a great deal of factual information seem to be taught better by the lecture method and seem to be so preferred by the students. Certainly at the college level one would expect the lecture method to be used extensively in the future as it has been in the past.
3. Some units of biology may be made more meaningful by the use of community resources. Students seem to enjoy this method. A different type of testing than was used in this experiment may be necessary to show this enjoyment.
4. For some reason which cannot be explained completely, Section II, the afternoon section, seemed to be motivated to excel on the material tested and to have a better attitude toward biology than did Section I, the morning section.

184 pages. $2.40

AN ANALYSIS OF THE DEVELOPMENT AND USE OF OUTDOOR LABORATORIES IN TEACHING CONSERVATION IN PUBLIC SCHOOLS

(L. C. Card No. Mic 58-928)

Clyde William Hibbs, Ph.D.
University of Michigan, 1957

The purpose of this study is to determine how different schools have developed and are using outdoor laboratories to provide conservation-learning opportunities. While visiting schools included in this study the writer had an opportunity to see the kind of laboratory facilities available in each community, discuss the outdoor laboratory program with school administrators, teachers, pupils, parents, and laymen in the community, and to observe and participate in a number of instructional activities conducted in outdoor study areas.

In addition to a general description of the problem, the first part of the dissertation deals primarily with the need for teaching conservation in public schools, the opportunities of using outdoor study areas in implementing a conservation education program, and the responsibility of the school administrator to provide capable leadership in this part of the curriculum. Suggestions are also made for the appointment and use of advisory groups and planning committees to provide opportunities for members of organizations, agency representatives, school personnel, and laymen of the community to cooperate in promoting conservation education in the local schools.

The second part of the study presents factors which should be considered when procuring and developing laboratory areas. The opportunities of using school grounds and other school-owned land for instructional purposes are discussed. Two examples are given to illustrate the potential possibilities of using land already owned by the school as an outdoor laboratory.

In many instances additional land is needed if the laboratory is to function efficiently in providing pupils an opportunity to student conservation problems. The legality of school districts acquiring land for instructional use is considered, and legislation in Michigan, Ohio, and Wisconsin has been cited to illustrate that a municipality or school district in these states can acquire and hold title to land for laboratory use, even though it may be located outside of the local school district. Factors which should be considered when selecting a tract of land to be used as an outdoor study area include: (1) a suitable location, (2) physical characteristics typical of the community, (3) opportunities to practice the multiple-use concept of resource management, (4) adequate size, and (5) it should include the entire watershed.

The methods used in a number of school districts to acquire laboratory areas are described, and recommendations made for use in planning and developing outdoor laboratories. These include: (1) the use of planning committees and resource inventories, (2) rate of laboratory area development, (3) extent of pupil participation in development activities, (4) methods of financing laboratory improvements, and (5) a suggested list of demonstration or study areas that may be included in the outdoor laboratory.

In the third part of the study, attention is given to the use of outdoor laboratory facilities to provide learning

opportunities necessary in implementing a sound conservation education program. Here consideration is given to: (1) the selection and assignment of personnel, (2) opportunities for school personnel to become acquainted with resources of the community and outdoor laboratory, (3) curriculum development in relation to the use of the laboratory, (4) types of teaching activities which may be conducted in the laboratory area, and (5) the problems commonly found in the schools visited.

From this study of schools using outdoor laboratories, ten guiding principles are formulated. It is hoped that these principles will result in the improvement of existing outdoor study areas and contribute to the establishment and use of new outdoor laboratories. 182 pages. $2.40.

FACTORS ASSOCIATED WITH PARTICIPATION BY MEN IN CAMPUS ACTIVITIES IN A MIDWESTERN COLLEGE

(L. C. Card No. Mic 58-952)

George Arthur Hyry, Ph.D.
University of Michigan, 1957

The purpose of this study was to analyze certain factors associated with the extent and type of participation in student activities by college men; to analyze certain factors associated with their problems in personal-social relationships; and to determine the association between the extent and type of participation in men's activities and problems in personal-social relationships at Eastern Michigan College, Ypsilanti, Michigan.

Participants in the study included 298 men, all undergraduates from second-semester freshman to senior year, inclusive, who lived in one of the two men's residence halls or dormitories. The mean and sigma of the whole group were used as the mean and sigma of an infinite population. The significance of the difference of means in subgroups was tested using normal variate t at the 1 per cent and 5 per cent levels. The test used was a two-tailed test. As a measure of linear relationship existing between the variables the Pearson product-moment coefficient of correlation was used.

The extent or degree of participation was recorded on a Participation Index. The respondents indicated, for a four-week period, the total amount of time (in hours) spent in all types, general and specific, of organized student activities. By means of the American Council on Education Inventory of Personal-Social Relationships, Part II the respondents expressed the degree and areas of concern, or problems, in their personal and social relationships.

Significant relationships were found between total participation and the following factors: year in college; age; curriculum hours, days, and time of work; per cent of earned college expenses; number of week-end nights spent off campus fraternity membership; committee officership; the four general types of activities--educational, general, recreational, and social; and government assistance (G.I. Bill).

There was a significant relationship between participation in the four general types of activities mentioned above and: committee-officer work; year in college; and fraternity membership.

Those students participating at the mean or higher in one activity also showed a general tendency to participate in other activities, and to an extent that was significantly above the group mean in each additional activity.

Low coefficients of correlation were found between total participation and the following: total inventory score; scores in the inventory classifications of social skill, social experience, belonging, likeness to others, faculty, home, physical well-being, and opposite sex; and distance of home residence from campus. There were also low coefficients of correlation between total inventory score and the score of each of the four general types of activities, and the score of each of the specific types of activities--class, club, intramural, college, drama-music, dormitory, sorority, honor and professional fraternity, religious, fraternity, student government, athletic team, and service fraternity. The correlations were likewise low between scholastic index and: four general types of activities; committee-officer work; hours of work per week; total participation; and total inventory score. A low correlation was evident between number of semesters in residence and week-end nights spent off campus.

Of the eight inventory classifications considered in their relation to organized noncredit student activities, social skill was of paramount concern to those who were nonparticipants.

Significant relationships were found between the total inventory score and the following variables: age, church preference; and government assistance (G.I. Bill).

Working for expenses, having to study, disinterest, other plans, and conflict with other activity were the five most frequent reasons, based on the average number of times mentioned, given for not participating in student activities. 205 pages. $2.70

THE SELECTION OF OUTSIDE SPEAKERS BY STUDENT ORGANIZATIONS AT THE UNIVERSITY OF MICHIGAN (1854-1935)

(L. C. Card No. Mic 58-937)

Stanley Newell Kinney, Ph.D.
University of Michigan, 1957

It was the purpose of this study to determine the extent to which student groups have set a policy for the selection of outside speakers at the University of Michigan. In a preliminary survey of the problem it seemed clear that administrative restrictions and supervisory controls over student organizations had increased and that the student's role in selecting outside speakers may have become curtailed. Therefore it became critical to identify some of the forces which had caused a shift in policy from one of nonrestriction to one of restriction.

The study covers the policies of student groups in the selection of outside speakers from 1854 to 1935. Records of student organizations and proceedings of various university administrative groups were used, but the most useful single source was the student press.

The study was limited to student organizations which were wholly responsible to the University of Michigan and particular emphasis was placed on groups whose purpose was to sponsor several lectures every year. There was no attempt to write a history of lecturing at the University

of Michigan, but, rather, to center attention on points throughout the period which were critical in determining the evolution of a policy of speaker selection.

The evidence indicates that changes in the extent of control over the student's choice of outside speakers for the University of Michigan were related to such factors as the growth of the University from an institution of 288 students in 1854 to an institutions of some 16,000 students in 1935; an urbanization of the university community which made it more difficult for student organizations to operate in an efficient and democratic fashion; friction between campus political groups; and mis-management in part resulting from the great increase in size of such operations demanded as the university community grew.

From 1854 to 1935 power over student organizations and their selection of outside speakers was centralized in the university administration and faculty. After World War I student leaders became aware of a loss of freedom and began a struggle to regain their "rights" by demanding representation on advisory boards dealing with student affairs. Their efforts seemed futile, and by 1935, it appeared to some student leaders that the restrictive atmosphere threatened the intellectual freedom of the university community.

The Hill Auditorium speaker-ban, instituted by the Board of Regents of the University of Michigan in 1913 when the building was first opened, prohibited the discussion of any political issue in the Auditorium. This rule became a point of contention between student groups and university administrators. Though there were slight modifications made to this ruling as a result of student pressure, by 1935 the speaker ban had become a blanket-rule covering all university buildings and had become a powerful tool to exclude allegedly "subversive" speakers from the campus.

The evidence indicated that the University's policy of increasing control over student discussion organizations and over the student selection of outside speakers was a result of a growing concern over the public relations of a state institution, and that the policy came to be more and more a matter of estimating the possible repercussions of public opinion. 133 pages. $2.00

A COMPARISON BETWEEN THE READABILITY OF DIGEST AND ORIGINAL VERSIONS OF ARTICLES

(L. C. Card No. Mic 58-938)

Sylvia Hivala Kinnunen, Ph.D.
University of Michigan, 1957

The purpose of this study was to compare the readability of selected articles from the Reader's Digest and the original versions of those same articles. Readability was evaluated by (1) measures of reader performance which included reading rate, immediate retention, and delayed recall, and (2) reader judgments of ease of reading and enjoyability.

Reprints of the digest and original versions of four articles representing two levels of difficulty were made in the Reader's Digest format. Multiple-choice tests were constructed for all of the articles. Some of the questions were over digest material and some over material omitted from the digest version.

Ninety adults participated in the study. They were divided into two equivalent groups on the basis of age, education, readership of the Reader's Digest, and reading rate and comprehension as measured by a standardized reading test. Each group read two articles in the digest form and two in the original form. The two articles read in the digest version by one group were read in the original version by the other group. A subdivision of the two groups made possible a further rotation procedure to cancel out differences which might result from the order of presentation of the two versions and two levels of difficulty. All participants were timed as they read; all took the same comprehension and delayed recall tests. Thus, it was possible to compare the performance and preferences of two equivalent groups reading two versions of the same articles.

The specific findings of the study may be summarized as follows: (1) The original versions of the articles were read at a faster rate than were the digest articles. The greater the degree of condensation, the greater was the difference. (2) The difficult articles were read more slowly in both their digest and original versions than were the easier standard articles. (3) Immediate retention was significantly greater for the readers of the original version on the total questions. (4) There were no significant differences between comprehension per unit of length nor between the amount of immediate retention on the material read by the respective groups. (5) Comprehension per unit of time was significantly greater for readers of the digest version. (6) Although the readers of the digest version were able to grasp the main idea, make inferences over the material contained in the digest version, and apply their knowledge as well as the readers of the original version, they could not answer factual or inference questions over the material omitted from the digest version beyond chance expectancy. (7) In absolute terms, delayed recall was significantly greater for readers of the original version, but both groups of readers performed equally well on the digest questions. (8) There were no significant differences in the percent of delayed recall over only the digest questions. The percent of recall over the total questions favored the readers of the digest version in three cases out of four, but in only one case was there a significant difference. (9) The readers found the original articles more enjoyable, but the digest articles easier to read by a ratio of almost two to one.

The general conclusions were that the condensation of articles does not make those articles more readable if objective measures of reading rate and immediate retention are employed. The delayed recall results were inconclusive. However, in the opinion of readers, digest articles are easier to read, although less enjoyable, than are original articles. The greatest advantage of digest articles appears to be that comprehension per unit of time is increased. 162 pages. $2.15

A STUDY OF THE STUDENT PERSONNEL RECORDS AT EAST CAROLINA COLLEGE AS RELATES TO PREDICTION IN ELEMENTARY ACCOUNTING

(L. C. Card No. Mic 58-1123)

Tora Marie Larsen, Ph.D.
University of Minnesota, 1957

In this investigation, four multiple regression equations were developed for predicting achievement in Business 140, the first quarter course in principles of accounting offered at East Carolina College. Two separate equations were developed for men and two for the women, one for each sex used past school records as predictors and the other used freshman placement test scores as predictors. Comparisons were made of the accuracy of the predictions for new groups of students.

The criterion of success was the grade earned by the student enrolled in Business 140 the first time. This grade was found to have high predictive power in determining which students would later complete all accounting courses required for graduation. The four predictors retained in the school record equations were the presence or absence of bookkeeping instruction prior to enrollment in Business 140, the first quarter quality point ratio earned at East Carolina College, and the grades in the two freshman courses, Business Mathematics and Introduction to Business. The three freshman test scores retained in the equations were the ACE--Q--score, the Cooperative Reading Comprehension Test--Vocabulary score, and the Cooperative College Mathematics Pre-test score. The equations were developed from the data of 104 men and 124 women enrolled in Business 140 between September, 1953, and May, 1955. These equations were applied to a second group of 33 women and 73 men enrolled in this course sometime between June, 1955, and December, 1955.

The correlations between the earned and predicted grades were computed for the men and women for each set of predictors. An analysis was made of the percentage of accuracy of the prediction from the two equations for each sex. Expectancy tables were developed showing the frequency of each earned grade for each predicted one.

Slightly more than one-third of all students enrolled in Business 140 for the first time earned unsatisfactory grades. Though the difference in the mean achievement of the sexes was not significant, the mean grade of the students enrolled the first time was significantly different from that of repeaters. The mean achievement of those who had had bookkeeping previously was significantly higher than the mean grade of those who had not had bookkeeping. Prior instruction in bookkeeping was more closely related to the achievement of the men than to that of women.

The women had a mean high school average, first quarter quality point ratio, and freshman composition grade significantly higher than the men though men had a mean ACE--Q--score significantly higher than the women.

The high school average, the freshman composition grade, the ACE--Q--score, the Speed of Comprehension and Level of Comprehension scores of the Cooperative Reading Comprehension Test were not significant predictors of achievement in Business 140 for either sex.

It was found desirable to have separate regression equations for predicting elementary accounting achievement for the men and the women because the factors considered carried different relative weights as predictors of achievement for the sexes. Presence versus absence of bookkeeping instruction prior to Business 140, the Business Mathematics grade, and the ACE--Q--score carried greater relative weight for the men. The first quarter quality point ratio, the Reading Comprehension Vocabulary score, and the Introduction to Business grade carried greater relative weight for the women. The Cooperative College Math Pre-test was significant as a predictor for the women but not for the men's group. The elementary accounting achievement of the men and the women was predicted with approximately the same degree of accuracy although the variables carried different relative weights by sex. The Business 140 grades were predicted with slightly greater accuracy from the school record data than from the test data.

404 pages. $5.15

AN INVESTIGATION INTO THE VALIDITY OF THE CPS PERSONAL ADJUSTMENT AND HUMAN RELATIONS TEST

(L. C. Card No. Mic 58-1432)

Eleanor Jean Maliche, Ph.D.
University of Michigan, 1957

This study is concerned with the validity of the Personal Adjustment and Human Relations Test, one of a battery used for certifying professional secretaries.

Procedure.--Performance on the test of fifty top-level secretaries were related to success in interpersonal relations on the job. Test results were also compared with performance on a judgment measure of tested validity. Criteria of success on the job were (1) ratings by immediate superiors and (2) observations by the investigator. An instrument, constructed by the investigator on the basis of the test content, called for two ratings of his secretary by each employer: (1) how well the secretary performed, and (2) how important the items were among the secretarial responsibilities required of his secretary.

Scope.--Interviews were held with fifty employers of fifty secretaries who later took the CPS examination and whose scores were then made available to the investigator.

Results.--No significant coefficient of correlation (-.05) was found between the candidates' performance on the human relations test and employer ratings. A small but positive relationship (r = .37) was shown to exist between test performance and investigator ratings of candidates' behavior as observed in the business environment. A small, positive relationship (r = .34) was also shown between performance on the human relations test and performance on the King Judgment Test. No significant differences between the pass and fail groups were found when employer ratings for each of the four components--mental, emotional, social, and physical--were studied. However, when the components were compared, it was found that employer ratings were higher for the social component than for any of the other components.

Conclusions.--From these findings it can be concluded that the Personal Adjustment and Human Relations Test is not predictive of successful human relations performance on the job, and therefore it is questionable whether this test should be included in the scoring of the CPS examination. However, it should be retained as part of the examination for its educational value--as stimulation and a guide to self-improvement in this area of secretarial job performance. Furthermore, the multidimensionality of this area suggests that the test, too, must be multidimensional, which makes the present practice of a single score for the Personal Adjustment and Human Relations Test meaningless. It would appear also from the analysis of employer ratings of individual items on the test that an on-the-job study of measurable human relations characteristics in top-level secretarial work would be advisable. 100 pages. $2.00

AN EXPLORATORY STUDY OF AN IN-SERVICE METHOD TO CHANGE TEACHER ATTITUDE

(Publication No. 23,655)

William Frederick McClintock, Ph.D.
The Claremont Graduate School, 1957

This exploratory study had three purposes, each related to a two-year action-research program of in-service education in one elementary school. The first purpose was to discover (1) whether the staff of twenty-three teachers could develop cohesiveness in their in-school social relationships; and (2) if twelve teacher volunteers could increase their use of promoting (positive) verbal behavior toward children who misbehave. The second purpose was to discover some of the problems introduced for teacher and principal when the principal accepts a dual role of administrative and in-service leader. The third purpose was to identify specific factors which contribute to success and difficulty in change in teacher attitude within the local school setting.

The school principal secured data by which the research problem could be analyzed. Because of the variety of interrelated factors in a complex setting, multiple instruments were used, as follows:

1. The faculty social relationship sociogram, used four times to study the changing faculty relationships.
2. The classroom observation guide, used three times to observe teacher use of promoting behavior.
3. The inter-personal relationship scale, used two times to indicate perceptions of change in attitude as seen by each teacher, a fellow-teacher, and the principal.
4. The evaluation questionnaire, used two times to rate the effectiveness of four in-service activities.
5. The interview, used by the experimenter and an outside consultant to locate factors contributing to success and difficulty in change.
6. The anecdotal log, used to record problems in the process of change for teachers and principal.

Change in teacher attitude. Cohesiveness developed in staff in-school relationships in that (1) faculty utilization of face-to face contacts was increased; (2) cliques did not form as permanent features of the school; and (3) new teachers became integrated as status equals.

Use of promoting behavior patterns toward children increased in that (1) ten of eleven volunteers used more promoting comments with children who misbehaved, eight changing ten per cent or more; and (2) ten of the eleven teachers became consistent in their practice of the type of comment they verbalized they would use in class, representing a gain of seven teachers. One additional teacher withdrew from the program.

Problems arising from a dual role of leadership. The use of a dual role as administrative and in-service leader brought about problems of two types, as follows:

1. Personal conflict for the leader when the additional role of in-service leader disrupted his administrative relationships with teachers and superiors.
2. Confusion and suspicion in the minds of some teachers about which role was being undertaken by the leader at any one time.

Factors contributing to success and difficulty in teacher change. Major factors contributing to success were the training activities, the development of a realistic teacher attitude concerning one's own part in change, the objectivity of the classroom observation guide, and the availability of the leader as counselor and morale builder.

Major factors contributing to difficulty were the problem of teacher resistance to change, the introduction of the training program too quickly, suspicion of the motives of the in-service leader, and excessive teacher dependency upon leadership.

Conclusions. Certain phenomena which contribute to the overall problem of change in teacher attitude should be understood by leadership. These include teacher ambivalence toward change, the complexity of teacher in-school relationships, and the pattern of administrative leadership.

Certain inter-related pre-requisites for change must be met within in-service experiences. These include readiness for change, ego-involvement, cooperative support, and release of creativity.

The leadership participation of the principal can be most helpful to teachers, provided he does not inquire too deeply into personalized relationships of his staff. He must clearly delineate individual counseling on professional problems and individual therapy, and avoid the latter. 265 pages. $3.45. Mic 58-4805

AN ANALYTICAL STUDY OF ACHIEVEMENT IN GRADE EIGHT GENERAL SCIENCE AND IN GRADE EIGHT GENERAL MATHEMATICS IN MINNESOTA PUBLIC SCHOOLS

(L. C. Card No. Mic 58-1158)

George James McCutcheon, Ph.D.
University of Minnesota, 1957

Major Adviser: Professor Palmer O. Johnson

Problem The study surveyed the achievement of Minnesota's eighth grade boys and girls in mathematics and science during the school year 1954-1955. The achievement was studied in relation to the organization of the public school attended, its eighth grade enrollment, certain pupil factors, and certain teacher factors.

Importance of Study New guides to instruction had just been published for elementary science and mathematics by the Minnesota State Department of Education. This was an ideal time to study the achievement of pupils in these subjects. It would make possible later follow-up studies.

Science and mathematics are now receiving considerable attention as crucial subjects for our advancement in a highly competitive scientific enviornment. A study of achievement in science and mathematics should reveal important educational information, some special attention to achievement of the gifted student at this level merits consideration.

Procedure A fifty item test in mathematics and a seventy-five item test in science were built from a large pool of items, after an item analysis was made from a pilot study on 800 suburban and rural pupils.

A stratified random sample of all Minnesota public schools having pupils in grade eight was drawn. County Superintendent Reports to the State Commissioner of Education gave accurate estimates of the strata totals for enrollment categories and for location and organization categories. A four by four table was used. All rural ungraded schools in a given county having an eighth grade enrollment were classified as a school unit for the sample.

Data from the pilot study gave estimates of the population mean and population variance and were used to determine the minimum size of sample needed. A sample of seventy-five schools was the minimum that would give a 95 per cent confidence interval of two score points on either side of the population mean. Eighty-five schools were actually used as the final sample. The school was used as the unit of sampling.

A letter explaining the purpose of the study and what was expected of each cooperating school was sent out from the office of the State Commissioner of Education to each of the eighty-five superintendents. Only two finally refused to participate.

A pre-test in science and in mathematics was given in the fall of 1954, and six months later a post-test in mathematics and in science was given. The Otis Quick Scoring Test Form Beta was used for measuring the intelligence quotient.

Questionnaires were sent to each of the three hundred seventy-eight teachers. There were six thousand four hundred seventy-one different pupils included in the study. The data were processed with IBM equipment.

Statistical techniques applied included: Cluster sampling statistics, "T" tests, "F" tests, analysis of variance and analysis of covariance.

Findings A sample of the findings follow. The analysis of covariance after adjustments for inequalities in pre-test score and intelligence quotient showed a significant difference favoring boys in the final achievement in science. No such difference was shown in mathematics.

The girls had higher mean scores in pre-test mathematics, post-test mathematics and in intelligence quotient.

When comparing the high five per cent in intelligence quotient with the low five per cent and the middle five per cent, there was a significant difference between the mean achievement of these three groups. The top and middle groups had significantly larger post-test scores in mathematics and science. The middle group was somewhat superior in final achievement to the top five per cent.

507 pages. $6.45

AN EXPERIMENTAL EVALUATION OF A STUDENT-CENTERED METHOD AND A TEACHER-CENTERED METHOD OF BIOLOGICAL SCIENCE INSTRUCTION FOR GENERAL EDUCATION OF COLLEGE STUDENTS

(L. C. Card No. Mic 58-1134)

Kenneth Victor Olson, Ph.D.
University of Minnesota, 1957

Major Adviser: Dr. Palmer O. Johnson

This investigation sought to determine whether a student-centered method or a teacher-centered method would result in better performance on criterion measures of abilities (1) to recall and apply biological facts and principles, and (2) to use some inductive aspects of scientific thinking.

A modern self-contained experiment employing principles of randomization, replication, and local control was designed and conducted using 1955-1956 Winter and Spring quarter classes (the biological part of a general education science course at Northern State Teachers College) as samples of the population-all non-science majors attending the college over an undefined period of time.

Data were secured by administering pre-, post-, and (in one case) re-tests of criterion measures. These included alternate forms of both quarter's subject matter constructed of items analyzed after use with former classes, Mary A. H. Burmester's Ability to Think Scientifically Test, and the Cooperative Biology Test. Reliability and validity estimates sufficiently reasonable were determined by appropriate statistical and/or curricular considerations.

Teaching methods representing conflicting educational philosophies were (1) a traditional, authoritarian or teacher-centered approach, and (2) a progressive, permissive or student-centered approach. The role of instructor (investigator) and students in determining objectives, selecting content, planning class activities, evaluating learning, and related aspects were differentiated and operationally defined.

Descriptive test statistics for samples under either treatment were presented. Data of replicate samples were combined to provide additional degrees of freedom for the error component. Inferences were drawn on the basis of (1) a two-way analysis of variance (two treatments by three intelligence levels), (2) F and t-tests of significance of differences between variances and means of boys and girls, and (3) a one-way analysis of variance and covariance of final scores holding pre-test and Otis intelligence scores constant.

Null hypotheses tested for each criterion measure stated that there were no significant differences between college students who underwent general education biological science instruction at Northern State Teachers College by either teaching method as regards:

(1) Mean initial and mean final performance.

(2) Mean final performance of upper, middle, and lower third intelligence levels assuming no interaction between treatments and intelligence levels.

(3) Mean initial and/or mean final performance of boys and girls.

(4) Mean final performance when inequalities of pre-test and Otis test scores are accounted for.

Results showed that:

For hypothesis one, generally, (1) mean subject-matter performance was increased significantly in both treatments, (2) differential retention of subject-matter did not persist upon re-test two months after Winter quarter instruction, and (3) mean scientific thinking ability performance was increased significantly in both treatments.

For hypothesis two, (1) no significant interaction between treatments and intelligence levels, (2) significant difference in mean performance among intelligence levels, and (3) no significant treatment differences in mean performance among intelligence levels. For scientific thinking ability, the last conclusion was confounded since the subclass variances were inhomogeneous.

For hypothesis three, (1) mean initial and final performance of girls consistently and significantly higher than boys in both treatments, (2) on one criterion - the 174C test of ability to recall and apply biological facts and principles - mean performance of control group boys significantly higher than experimental group boys, and (3) no significantly different mean performance between boys and girls under either treatment.

For hypothesis four, (1) mean subject-matter performance of control method students higher than experimental method students, and (2) mean performance of students in some inductive aspects of scientific thinking ability not significantly higher under either treatment.

325 pages. $4.20

CONTRIBUTIONS OF BUSINESS LAW TO GENERAL EDUCATION AND THE DEVELOPMENT OF COURSE MATERIALS FOR USE AT A STATE COLLEGE

(L. C. Card No. Mic 58-1276)

Alvin Peter Pierson, Ed.D.
Stanford University, 1958

The purpose of this study is an outgrowth of the currently burgeoning general education movement, which is too well established and pervasive to create much argument, at least so far as its existence is concerned. An exponent of this trend, the author has long believed that the study of law can make contributions to the broad training of all students. Because it has been little utilized for such an objective in this area, he undertook this study to explore the proposition and, should conclusions so justify, to formulate and develop materials for an undergraduate college law course, to be taught as a part of the liberal arts curriculum.

The procedure was, first, to review general education literature and objectives, and to analyze the contemporary educational situation with respect to possible use of law materials therein. The next step was to investigate research studies, law courses, and conferences which might be pertinent and helpful in determining the benefits to be derived from legal study by liberal arts students and which would serve as a guide in selecting the course content. A thorough digest was made of the findings, observations, and conclusions drawn from all sources dealing with the role of law as a fundamental for the undergraduate.

Following these steps, the author set about defining and limiting the area of law materials, in this instance to substantive law, which involves individual rights and responsibilities as applied in the fields of contacts and common torts. He then solicited suggestions from authoritative sources (270 questionnaires to Federal judges and teachers of college business law) for cases within the designated areas which these authorities deemed valuable for general education.

The results of these investigations were as follows: they indicated that the study of law could make definite contributions toward general education, principally through the use of law cases to develop the skills of critical analysis, creative thinking, and sound judgments. The dissertation sets forth many conclusions and recommendations derived from the study and elaborates upon the construction and content of the course being developed.

Therefore, from the revelations of the dissertation proper and the abundance of material suggested by the 142 respondents to the questionnaires, the author subsequently selected and edited the most appropriate cases for inclusion as the basic portion of this exploratory text. In addition to these cases a large amount of supplementary material has been included, such as legal background, questions and review cases for class discussion, a Glossary, the Uniform Sales Act, and suggested reading references.

Because the research indicates the high desirability of such a course, the Appendix to the dissertation is a complete textbook (506 pages) for a one semester 3-unit law course, planned for general education purposes.

689 pages. $8.75

THE METROPOLITAN DETROIT BUREAU OF COOPERATIVE SCHOOL STUDIES: A HISTORY AND EVALUATION

(L. C. Card No. Mic 58-1189)

Floyd Nester Reister, Ed.D.
Wayne State University, 1957

Supervisor: Dr. Roland C. Faunce

This study was designed to trace the history and development of the Metropolitan Detroit Bureau of Cooperative School Studies and the school study council as a whole, to determine the purposes of the Bureau, and to evaluate the degree of realization of these purposes. The study proposed to determine why some school systems in the six county metropolitan Detroit area to whom the opportunity for membership was available have joined the Bureau and why others have not joined, the extent to which the Bureau's activities and publications are known and valued, and the Bureau's influence on educational practices in the area it serves, as indicated by the judgments of members and non-members of the Bureau.

The historical and developmental phase of the study was developed from materials in the Bureau files and from professional literature.

The evaluations of the Bureau were obtained by means of a questionnaire submitted to a selected sample of school personnel. The respondents indicated their knowledge of and experience with the Bureau relative to the items listed above.

The major conclusions reached as a result of this study were:

1. The Bureau's purposes, as conceived by the respondents, were very like the stated purposes of the Bureau and its committees. The achievement of these purposes, both conceived and stated, was asserted by the respondents to be at a high degree of accomplishment.
2. The major purpose for joining the Bureau was to be a recipient of the services they felt the Bureau could render.
3. The reason most cited for not joining the Bureau was that of a lack of knowledge about the Bureau, its purposes and functions.
4. There was greater familiarity and knowledge about Bureau activities and projects which were of local origin.
5. There was greater value placed on those activities and committees of which there was greater knowledge and which the familiarity was greatest.
6. The major source of information about the committees and their activities was the reports of the committees.
7. The Bureau publications have had wide influence and circulation in member and non-member school systems. The influence of the Bureau publications was reported in their own and in other schools by both members and non-members of the Bureau. The Bureau publications are valued as sources of advanced trends in educational practice in the area served by the Bureau.
8. The Bureau has served an educational need in the metropolitan Detroit area for the past ten years.
9. There are many more areas in which the services of the Bureau can be brought to bear on educational problems.

A summary of the recommendations made as a result of this study are:

1. The Bureau should increase its efforts to involve more of the staff of member schools in Bureau activities.
2. The Bureau should increase its efforts to enlarge the membership of the Bureau.
3. The Bureau should increase its staff by adding consultant help and by adding to the permanent staff.
4. The Bureau should coordinate all its activities through a council of the chairmen of the various committees.
5. The Bureau should increase its budgetary allowance for Bureau publications.
6. The Bureau should initiate, encourage, and supervise system-wide research of the action type in member school systems.
7. The Bureau should seek monetary grants to aid in the development of system-wide longitudinal research and other action-type research.
8. The Bureau should encourage the distribution of reports and other publications to all staff members of the member school systems.
9. The Bureau should encourage and initiate the exchange of periodic information and research results among school study councils.
10. A school study council or the National Conference of School Study Councils should unify the research results reported; research and projects in progress, including progress reports; and projects and research being planned, into a yearly report which would be sent to every school study council and its members. 260 pages. $3.35

A STUDY OF COLOMBIAN NATIONALS WHO ATTENDED COLLEGIATE INSTITUTIONS IN THE UNITED STATES

(L. C. Card No. Mic 58-986)

Robert Allen Schuiteman, Ph.D.
University of Michigan, 1957

Assuming that the ultimate willingness, ability, and success of United States educated foreign persons to promote international understanding and cooperation depends, in part, both upon many facets of the educational experience and upon the ease and degree of reassimilation into the original culture, the purpose of this study is to assess the opinions of 116 Colombian alumni who attended collegiate institutions in the United States, with regard to certain phases of their education and the climate surrounding their return home.

Some of the questions which the study strives to answer concern: anticipations and objectives and their degrees of fulfillment; difficulties encountered and means of resolving them; services available and their helpfulness; attitudes toward foreign learners on the part of Americans; experiences beyond the academic considered valuable; activities which assisted the students in understanding the United States; opinions regarding life and the practice of democracy in the United States; changes the alumni would desire if they were to repeat their educational sojourns; opinions regarding their social and occupational realignment to the native environment; methods by which educational institutions can render optimum service to foreign students. Since colleges and universities are primarily

responsible for the welfare of foreign students in America, it is hoped that the answers to questions such as these will assist educators in evaluating the success of their own endeavors and those of the institutions which they represent.

Colombia, South America, was selected as the site of this study because it has ranked high among Latin American nations in terms of numbers of students in the United States, and because Latin America has been largely neglected by researchers in the field of cross-cultural education.

Colombian nationals who had attended collegiate institutions in the United States during the academic years 1937-38, 1943-44, 1946,47, and 1949-50, residing in Bogota, Cali, Medellin, or Barranquilla constituted the population from which the sample was drawn. As a truly random sampling technique could not be employed, the selection of the participants was largely determined by the accessibility of the alumni and the writer's available time. Within these limitations respondents were chosen to represent as many dimensions as possible of the following criteria: (1) geographical location of institution attended; (2) sex; (3) financial sources; (4) type of institution attended; (5) academic major.

Data were obtained by personal interviews and the responses coded and transferred to IBM cards for statistical treatment. Confidence limits were provided for many of the findings. The data were occasionally subjected to cross tabulations, and a test of the differences of percentages employed.

From the findings, eight broad conclusions can be drawn for the sample and for the parent population of which the sample might be representative. The data indicate that, for the most part:

1. The Colombians fulfilled their purposes for studying in the United States.
2. The difficulties encountered did not appear insurmountable.
3. The services and facilities, such as language instruction and counseling, were considered helpful and were appreciated when available.
4. The alumni were pleased with their courses and the competency of their instructors.
5. The alumni found Americans warm and favorable toward foreign students.
6. They participated in and considered worth while many non-academic experiences.
7. They were favorably inclined toward the way of life in the United States: the percentage of those having favorable opinions increased significantly by the time the alumni returned to Colombia; but the worst impression was racial prejudice and discrimination.
8. They appeared to have realigned themselves satisfactorily with their native environment and to have attained an improved occupational status.

These conclusions give indication that the majority of the Colombians hold friendly and satisfied feelings toward the United States and should be in a position to contribute to international good-will. 279 pages. $3.60

THE EFFECTIVENESS OF TWO INSTRUCTIONAL PROCEDURES IN COMPARATIVE EDUCATION

(L. C. Card No. Mic 58-996)

Hayden Richard Smith, Ph.D.
University of Michigan, 1957

In this experimental approach to the study of two different methods of teaching at the college level, the education of underdeveloped people was chosen as the instructional content. The general question was "How best can educators instill in students favorable attitudes toward international organizations such as Unesco and its program to aid underprivileged people, as conducted at the Fundamental Education Center in Patzcuaro, Mexico?"

Whether an instructional procedure which used a motion picture would effect desirable attitude changes more than a lecture was the specific problem. It was hypothesized that the discussion of a documentary film would be a more effective instructional procedure for producing favorable attitudes toward a specific subject area in comparative education than the informal lecture method. It was further contended that instruction which utilized either of these procedures would result in a shift of attitudes favorable to the subject, that this shift would persist, and that no favorable change would occur for a group in which no instruction was given.

The experimentation was conducted in twelve introductory education classes at the University of Michigan. Two hundred and sixteen students, divided into two experimental groups and one control group, were used as subjects. It was determined by pre-test, through Form A of the Remmers Generalized Attitude Scale, "A Scale for Measuring Attitudes Toward any Institution," that the initial attitudes of the groups were equivalent. Each of the experimental groups was exposed to a different instructional procedure, the film discussion or the lecture discussion method. No stimulus was introduced into the control group. A twenty-three minute documentary film, produced by the writer, which portrayed the training of fundamental education workers at the Unesco project in Mexico, was used with the film method. The lecture method utilized an outline based upon the same subject content as the film.

During two regular class periods each student in the film group was shown the film twice and had the opportunity to participate in a discussion about it. Each student in the lecture group listened to two lectures and was given the opportunity to engage in discussion of them. At the close of the sessions the experimental groups, as well as the control group, were given Form B of the Remmers Scale. Approximately two and one-half months later each group was given Form A of the attitude test to determine the persistence of the effect. Also, comparisons were made of the scores of those individuals found within the lowest quarter of each group, as indicated by the pre-test, to determine if the instructional procedures might be more effective with individuals initially less favorable.

Comparisons which were made with the pre-test, post-test, and persistence-test data for the film group and its lowest quarter, revealed that the changes in attitudes were statistically significant ones, which persisted. While these comparisons yielded the same result within the lowest quarter of the lecture group, no significant changes were found within the total lecture group. This would indicate that the film method was as effective with those persons

initially more favorable as it was with those less favorable, whereas, for the lecture group, the lecture method was only effective for those initially less favorable.

While these comparisons tended to favor the film method of instruction, the comparisons between the two procedures failed to do so. These involved comparisons of the amount of attitude shift within the film group with the amount of attitude shift within the lecture group. In no instance were these differences found to be statistically significant. However, in view of the fact that no significant difference occurred within the control group, it was concluded that carefully planned instruction, utilizing either the film or lecture method, resulted in producing attitudes more favorable to the subject under consideration.

157 pages. $2.10

IMPLICATIONS OF TELEVISION FOR INDUSTRIAL ARTS

(L. C. Card No. Mic 58-1184)

J. Asbury Smith, Ed.D.
Wayne State University, 1957

Supervisor: Dr. G. Harold Silvius

The purpose of this study was fourfold, but paramount was the compilation of a brochure of production practices and techniques for telecasting industrial arts activities. Concomitant objectives were: (1) to identify significant practices for the brochure, (2) to report the scope of participation in telecasting industrial arts activities indicated by respondents in the study, and (3) to review the educational television movement as revealed by pertinent literature.

Identification and Selection of Practices for Brochure

Identification of significant practices consisted of two relevant phases. One, the compilation of an inventory of 131 statements designed to reflect a favorable viewpoint with respect to individual production practices employed in telecasting industrial arts activities; and two, evaluation of each statement in the inventory by industrial arts teachers and persons in related professions who have presented industrial arts activities; and two, evaluation of each statement in the inventory by industrial arts teachers and persons in related professions who have presented industrial arts activities on television.

Practices of which the inventory was composed were grouped in seven categories:

Personal Appearance and Poise
Opening and Closing
Selecting the Subject and Writing the Script
Presenting the Program
Selecting and Preparing Visuals
Station Policy
Program Evaluation

Participants in this aspect of the study were identified in a nation-wide poll of 660 industrial arts supervisors and 393 television program directors who contributed names and addresses of 480 different persons who had been active in this field. A total of 273 respondents evaluated practices in the inventory and returned completed copies of the instrument. Their response to each practice was made on the basis of the following criteria:

S--Significant in telecasting
I--Important in telecasting
D--Of doubtful value in telecasting
N--No experience with this practice

Selection of sixty-six items for the brochure was governed by five factors:

1. Subjective appraisal of data from evaluation of inventory
2. Relevance of practice to industrial arts
3. Repetitious duplication with other items in the list
4. Frequency and content of comment concerning an individual practice
5. Frequency practice was reported to have been used effectively

Techniques for Implementing Selected Practices

Each participant who indicated practices which had been used effectively was solicited for descriptions of techniques for implementing each of two designated practices. A total of 127 of the 188 participants responded to this request and contributed techniques which they had employed. A descriptive summary of techniques was prepared for respective practices in a manuscript for a brochure that was submitted to television program directors for their editorial and critical reactions.

Evaluation of Manuscript for Brochure

Program directors who participated in this phase of the study were identified in the nation-wide poll of industrial arts supervisors and television program directors. The manuscript for the brochure was submitted to seventy-seven program directors of whom fifty-one responded with letters and editorial and critical suggestions. This appraisal resulted in combining two practices and their accompanying descriptive technique, and the rejection of seven others, leaving a remainder of fifty-eight of which more than half the techniques summaries were revised in accordance with suggestions and comments from this group.

Scope of Television Participation

Accompanying the inventory was an instrument to ascertain the scope of television participation of respondents. An appraisal of the data furnished by this instrument showed that:

1. Most telecasts were live demonstrations in woodworking, metalworking, or handicrafts.
2. Most programs were thirty minutes in length and were presented on a week-day afternoon to an audience of both children and adults.
3. The sponsoring agency was the school which also furnished most of the equipment used, but rarely provided additional time for preparation or remuneration for the extra responsibility.

The items following each abstract are: the number of manuscript pages in the dissertation, its cost on microfilm, and the Library of Congress card number. Enlargements 5-1/2 x 8-1/2 inches, 4 cents per page. No postage is charged if check or money order accompanies order.

Conclusions

Three particularly relevant conclusions drawn from the findings were:

1. Action of the Federal Communications Commission in 1952 in allocaing 242 channels for educational purposes provided the first opportunity for portraying industrial arts activities for purposes of instruction and public understanding, since the inception of industrial arts as a phase of general education.
2. Television is an effective medium for presenting instruction, and can be depended upon to maintain interest, create understanding, promote skills, insure learning and retention, and is generally acceptable to viewers.
3. A positive interest was manifest in the response of industrial arts teachers, supervisors, and others in related professions; indicating their enthusiasm for the medium and their optimism for its future application in televising industrial arts instruction.

Recommendations

These may be classified in three groups: (1) general, (2) recommended to state and national organizations, and (3) other recommended studies.

General recommendations include suggestions to teachers, supervisors, and college departments of industrial arts to study television for its possible use in direct instruction to children both in school and out, for in-service education of teachers in rural as well as urban areas, and for guidance of children and adults in home-workshop situations.

Suggestions to state and national associations of industrial arts teachers indicated continued emphasis of television for convention program topics; encouraged the use of clinics and workshops; advised the formation of permanent committees to define the issues and problems of television related to industrial arts; and pointed out the need for correlating the work of industrial teachers and other groups with respect to the function of the Educational Television and Radio Center at Ann Arbor, Michigan.

The investigation revealed this needed research:

1. Development of course content for industrial arts subjects
2. Effect of television participation on student motivation
3. Using television for home workshop instruction
4. Registration procedure and method of assigning credit for participation in televised industrial arts courses. 352 pages. $4.50

THE CONTRIBUTION OF CRAFT ACTIVITIES TO THE PHILOSOPHY AND OBJECTIVES OF BOYS' CLUBS OF AMERICA: THE EXTENT TO WHICH SPECIFIC CRAFT ACTIVITIES IN THE CURRENT PROGRAMS OF BOYS' CLUBS MAY CONTRIBUTE TO THE ATTAINMENT OF THE STATED PHILOSOPHY AND OBJECTIVES OF BOYS' CLUBS OF AMERICA

(L. C. Card No. Mic 58-641)

Elizabeth Alban Trumbower, Ph.D.
New York University, 1957

The purpose of this study was to determine the relative values of the craft activities used in the greatest number of Boys' Clubs for their contribution to the development of the stated philosophy and objectives of Boys' Clubs of America.

Pertinent data concerning the philosophy and objectives of Boys' Clubs of America were gathered from literature approved by the National Council of Boys' Clubs of America and published by Boys' Clubs of America, National Office. Fifty-seven criteria were developed from statements of the philosophy and objectives of Boys' Clubs of America.

Information concerning craft programs in Boys' Clubs was obtained from replies to questionnaires completed by 74% of all of the Boys' Clubs in the United States and from annual reports submitted by 325 Boys' Clubs to the National Office. Personal visits were made to selected Boys' Clubs. Programs were observed. Executives and craft leaders furnished information regarding programs in their clubs, Additional data were obtained at the 1957 National Convention, Boys' Clubs of America, in Detroit. Club leaders from many parts of the country supplied data concerning programs in individual clubs and the people responsible for their implementation.

Craft media, craft processes, and craft activities used in the greatest number of Boys' Clubs were ascertained, as well as information concerning types of craft program employed, sizes of craft groups, numbers of boys working with one leader, lengths of craft sessions, the popularity of crafts compared with other program areas in Boys' Clubs, most popular projects made in craft programs, and other characteristics of craft programs.

Based on criteria developed from philosophy and objectives and data concerning programs an instrument was devised for use in determining the contribution of craft activities to the stated philosophy and objectives of Boys' Clubs of America. Two teams of two judges each, having specific qualifications, evaluated each of the selected craft activities in terms of the extent of its contribution to the development of each component of criteria. Individual evaluations of the judges, the combined evaluations of judges as a team, and the combined evaluations of the two teams were bases for conclusions.

Crafts were part of a total program of educational and recreational activities conducted by 93% of the Boys' Clubs in the United States. A variety of craft media, craft processes and craft activities were employed in the craft programs of Boys' Clubs. Craft activities differed in the extent to which they contributed to the stated philosophy and objectives of Boys' Clubs of America. Craft activities used in the greatest number of Boys' Clubs made a contribution to the extent of 58% of the maximum possible. The total of the five craft activities used in the greatest

number of Boys' Clubs within each of the six media used in the greatest number of clubs made a contribution similar in extent.

Crafts ranked second and third in popularity in 73% of the clubs, and ranked first in popularity in 13% of the clubs. The greatest contributions of craft programs to boys were: skill, creative expression, leadership and personality development, program enrichment and an alternate interest for athletics, guidance, avocational direction, and vocational exploration.

The instrument developed and used in this study may be employed further for evaluating other aspects of craft programs and other program areas in Boys' Clubs. The results of this study may help in the planning of craft programs in Boys' Clubs, and the guiding principles developed from this study may aid executives, program directors, and craft leaders in the conduct of craft programs for boys.

436 pages. $5.55

THE STUDENT COURT IN NEW JERSEY'S PUBLIC SECONDARY SCHOOLS

(Publication No. 23,291)

Chester Ervin Wilhelm, Ed.D.
Rutgers University, 1957

The problem. The study proposed (1) to ascertain the status of the student court in New Jersey's public secondary schools; (2) to record a history of the school courts for the decade 1943 to 1953; (3) to find out how the courts were organized for functioning; (4) to bring to light objectives toward which the courts strove. The emphasis of the problem was on the pupil-personnel aspects involved.

Sources of data and methods of investigation. Data were obtained chiefly from questionnaires to (1) principals; (2) sponsors; (3) members of courts; (4) defendants; (5) pupils-at-large; and (6) educational authorities. Additional information was obtained from interviews and observations

Tables were prepared to show numbers and percentages of responses to the items of the questionnaires. Where ratings were solicited, a four-point scale ranging from zero (of no value) to four (of excellent value) was devised. It was patterned after that of the Evaluative Criteria (1950 edition).

Where it was desired to ascertain if there were statistically significant differences in the percentages of group reactions to similar items, the formula $S.E._{D\%} = 100\sqrt{\frac{p_1 q_1}{N_1} + \frac{p_2 q_2}{N_2}}$ was used. Where the actual difference in percentages exceeded this latter statistic by 1.96, or more, times, the study deemed that, although cause and effect conditions had not necessarily been located, factors deserving of further study had been unearthed.

Summary of findings. Approximately one-fifth of New Jersey's public secondary schools utilized student courts. Organized, generally, as multi-judge or judge-and-jury courts, the majority operated under jurisdiction of student councils. Growth was static during the decade 1943 to 1953.

Seven objectives, judged to be attainable by a rating within the range of "good," were found to be common ones. Of these, the following were reported most frequently: (1) to give guidance in respect for law and order; (2) to inculcate the habit of discipline "from within" rather than by means of "authority from without"; (3) to help students respect school rules.

Among the positive values found in the school courts were the following:

1. Court membership did not cause lessened esteem of peers.
2. Court decisions were deemed by defendants to be fair ones.
3. "Pals" were not favored by members of the courts.
4. Pupils held that court decisions were "backed" by school authorities.
5. Pupils judged that their parents approved of school courts.
6. Pupils preferred "trial" by peers to action by school authority but indicated that they would obey teachers more "willingly."
7. Defendants, generally, judged that court action had resulted in their desiring to cooperate.

An inconsistency of concept was found in that defendants and pupils-at-large deemed the "punishing of wrong-doers" to be a purpose of their courts but sponsors and court members held otherwise. Generally, court actions were punitive in nature. Although the study did not establish the practice as being necessarily contrary to the intent of educational law, the punitive use of school courts should not be condoned because (1) New Jersey educational law prohibits corporal punishment; and (2) juvenile powers conferred by law cannot be delegated.

Experts disagreed regarding the merits of student courts but judged them less favorably than did pupils and professional personnel of schools where courts were used. Despite inconsistency between the philosophy of the courts and the punitive practices found, positive values were unearthed. In schools where they were used, strong expression was evidenced for the continued use of student courts.

Conclusions and recommendations. Schools should provide experiences in the positive values offered by student courts. However, formal punitive courts should be replaced by informal pupil-agencies. Punishment should be removed from the prerogative of pupil-agencies and counsel of peers should replace punitive action for purposes of improving peer behavior.

Further lines of investigation to implement these recommendations were pointed out by the study.

567 pages. $7.20

The items following each abstract are: the number of manuscript pages in the dissertation, its cost on microfilm, and the Library of Congress card number. Enlargements 5-1/2 x 8-1/2 inches, 4 cents per page. No postage is charged if check or money order accompanies order.

EDUCATION, ADMINISTRATION

A STUDY OF ELEMENTARY SCHOOL TEACHERS' ATTITUDES TOWARD THE WOMAN PRINCIPAL AND TOWARD THE ELEMENTARY PRINCIPALSHIP AS A CAREER

(L. C. Card No. Mic 58-878)

Alice Knar Shamlian Barter, Ph.D.
University of Michigan, 1957

Purpose of the Study

The purpose of the study was to gather data about the present status of women in elementary school administration and about attitudes of elementary school teachers which contribute to that status.

Methods of Research

Questionnaires were sent to all of the men teachers and twenty-five per cent of the women teachers in eighteen Wayne County, Michigan, school systems. The teachers' questionnaire included two Thurstone-type scales measuring attitudes towards women principals, two charts for rating the abilities and personal qualities of men and women principals, descriptions of five types of principals to be ranked in order of preference, questions about the teachers' interest or disinterest in the principalship as a career and about their attitudes towards the promotional policies of their school systems.

A shorter questionnaire about promotional policies was sent to the superintendents of each school system. Six hundred and nine or 76.5% of the teachers' questionnaires and all of the superintendents' questionnaires were returned for use in the study.

Findings

Findings from the attitude scale measurements included the following:

1. Women teachers were more favorable towards women principles than men teachers were.
2. Teachers with the least or the most teaching experience were more favorable toward women principals than those with other terms of experience.
3. Women interested in the principalship as a career were more favorable towards women principals than women not interested in that career.
4. Men teachers having teaching experience with women principals were more favorable toward them than men having no experience with them.
5. There was no significant relationship between the size of the community in which the teacher taught and his attitude toward women principals.

Other findings were as follows:

1. Forty-eight and nine tenths per cent of the men teachers and 30.6% of the women teachers had had no experience with women principals.
2. The majority of teachers rated men and women principals equal in abilities and personal qualities.
3. Forty-five and eight tenths per cent of the men but only 7.8% of the women teachers were definitely interested in the elementary principalship as a career.
4. Men teachers were better prepared academically than women teachers for appointments to the principalship.
5. The men most interested in appointments to the principalship were those who had taught for less than six years.
6. A preference for teaching was given by both men and women teachers as their chief reason for disinterest in the principalship as a career.
7. Most teachers felt their systems showed preference for men in appointments to the principalship.
8. Only six of the eighteen school systems had definite policies for promotion to the elementary principalship. No system stated a policy favoring men in appointments to the principalship.
9. The proportion of men and women principals in these systems was four men to every women.

Conclusions

On the basis of the data gathered in the study, the following conclusions were formulated:

1. Although women elementary school principals were definitely in the minority in the systems studied, it seems reasonable to believe that qualified women seeking such appointments will be given fair consideration.
2. Although men teachers on the whole have a decided preference for men principals, women teachers do not. Since the majority of elementary school teachers are women, the attitudes of elementary teachers towards a woman principal should not be a great obstacle to her success as an administrator.
3. However, the number of women holding administrative positions will decline regardless of attitudes towards women if more women do not prepare themselves for these positions and if the great majority of them continue to reject the principalship as a career.

241 pages. $3.15

THE NATURE AND EXTENT OF EDUCATIONAL PROVISIONS FOR THE GIFTED IN SELECTED ELEMENTARY AND JUNIOR HIGH SCHOOLS

(Publication No. 24,895)

Dorothy Alperowich Bernstein, Ph.D.
Northwestern University, 1957

Advisor: Paul A. Witty

The purpose of this study was: to investigate the nature and extent of educational provisions for the gifted in selected elementary and junior high schools, to describe and analyze the present trends in such programs, and to compare the practices found in this study with those recommended by research workers in the field of the gifted.

A questionnaire was sent to school personnel found to be making educational provisions for superior and talented students in elementary and junior high schools. Personal interviews and visits were held with certain educators actively engaged in working with the gifted.

Schools doing outstanding work with superior students were identified through a study of the literature; through

letters sent to state departments of education; through letters and questionnaires sent to city superintendents, principals, teachers, psychologists, guidance counselors, and curriculum coordinators; and through letters addressed to recognized authorities. Three hundred fifty-seven questionnaires were sent and two hundred eighty-two replies were received.

Respondents reported the following provisions for the gifted:

Acceleration - a means of rapid advancement or grade skipping.

Grouping - in special schools, classes, or workshops.

Enrichment in regular classrooms - in which children are given rich and varied opportunities to develop their outstanding abilities and interests.

A variety of successful practices are in operation for the gifted in elementary and junior high schools. However, educational provisions for the gifted are generally meager and inadequate.

Special schools for the gifted at the elementary and junior high school levels are rare. In this study only two special schools were reported.

In no instance in this study was acceleration reported as the sole educational provisions for the gifted. In most cases acceleration was considered an expedient to be used only after the physical, social and emotional maturity of each pupil was studied. Acceleration was usually employed in association with enrichment.

Ninety-four educators reported enrichment in special classes as their chief objectives. This practice was generally accompanied by moderate acceleration and was employed in the regular classroom in which gifted children were grouped for some of their instruction.

Enrichment in the regular classroom was the most frequently reported provision. One hundred forty-three educators indicated this practice. Some of the replies describing this plan were indicative of most meager provisions. Others were specific, including descriptions such as the use of homogeneous grouping within the class, provision for work upon individual and group projects, emphasis on research and experimentation, and the use of differentiated assignments. Opportunities for creative writing and the study of a foreign language were also reported frequently.

The replies to the inquiries revealed an increased interest in: the formation of special classes, the use of committees in planning programs, the tendency to adopt a broad definition of giftedness, and a consideration of factors in addition to a high IQ in identifying the gifted.

This study, like others, suggests that gifted pupils, many of whom are currently neglected, require early identification, guidance and special opportunities to develop to their maximum. However, the importance of utilizing fully the contributions to be made by gifted children and youth is increasingly recognized as essential for the welfare of our nation. But, provisions are still woefully inadequate. 232 pages. $3.00. Mic 58-4807

A STUDY OF THE ARITHMETIC CONCEPTS POSSESSED BY THE PRESCHOOL CHILD AT THE TIME OF ENTRANCE INTO KINDERGARTEN

(L. C. Card No. Mic 58-1172)

Corwin E. Bjonerud, Ed.D.
Wayne State University, 1957

Supervisor: Dr. Charlotte Junge

The average kindergarten program being used in our schools today treats arithmetical learnings in an incidental way. Systematic instruction in arithmetic has not often been a part of the kindergarten curriculum. The primary purpose of this study was to determine the arithmetical concepts possessed by the preschool child at the time of entrance into the kindergarten. The secondary purpose was to determine the differences, if any, that exist in arithmetical understandings between boys and girls.

Two tests were developed to aid in securing the needed data. One test was designed to be administered as an oral interview on a one-to-one basis in a room outside of the normal classroom. The other test was a written test composed of pictures and number symbols, it was administered to a small group of children at one time in the regular kindergarten classroom.

One hundred unselected children participated in the experiment. This group was composed of sixty boys and forty girls who were members of three different kindergarten classes taught by three different teachers. All of the children were tested within the first two and one-half months of their kindergarten school year. The children ranged in chronological age from four years and nine months through five years and nine months. Each child resided in a new housing development in a suburban community.

Conclusions

1. It may be concluded under the conditions of this study, that a large percentage of beginning kindergarten children possess the ability to do rote counting by one, while a smaller percentage possess the ability to do rote counting by ten.
2. The results of the data seems to indicate a marked similarity between the ability of preschool children to do rational counting by one and to do rote counting by one.
3. It may be safe to infer from the results of the oral interview that few of the children possess an understanding of simple number sequences.
4. The data presented in this study show that more than one-half of the beginning kindergarten children have some understanding of ordinal numbers.
5. It appears that these beginning kindergarten children possess considerable understanding of number selection skills, and are able to recognize a quantity of items numbering less than four immediately, while some are able to recognize more than four items but less than nine items immediately.
6. The results of the data seems to indicate that the majority of beginning kindergarten children possess the ability to recognize the number symbols, but few are able to recognize the written number words.
7. It may be concluded under the conditions of this study that a large percentage of beginning kindergarten

children possess a high degree of understanding of terms describing pre-measurement concepts, and are able to recognize several common instruments used in measurement.

8. The results of this study seem to indicate that some preschool children have developed the ability to recognize time on the full hour and on the half hour.

9. It may be safe to infer from the results of the oral interview that the children participating in this study possess an inconstant understanding of United States coins and their comparative values.

10. It appears that the majority of preschool children possess the ability to recognize the geometric figures of a circle and a square.

11. The results of this study seem to bear out some understanding of simple fractional concepts by a large percentage of the preschool children participating in this study.

12. It may be concluded from the conditions of this study, that beginning kindergarten children possess a high degree of skill in solving work problems that involve simple addition and subtraction facts.

13. The comparison between the number concepts possessed by the girls, seems to warrant the conclusion that of the boys and girls participating in this study, the boys hold a slight advantage over the girls. 153 pages. $2.05

AN HISTORICAL STUDY OF THE OFFICE OF COORDINATOR OF TEACHER EDUCATION IN THE CANADIAN PROVINCES OF NEW BRUNSWICK, ONTARIO, SASKATCHEWAN, ALBERTA, AND BRITISH COLUMBIA

(L. C. Card No. Mic 58-890)

Marjorie Mitchell Cann, Ph.D.
University of Michigan, 1957

This study presents an historical sketch of education in Canada and the evolution of the administration of teacher education as a separate function within five of the Canadian provinces. The provinces of New Brunswick, Ontario, Saskatchewan, Alberta, and British Columbia have an office within their provincial departments of education known as the coordinator of teacher education, and it is these provinces that receive particular attention in the study. The title "coordinator of teacher education" is used to refer to the official appointed by a provincial government to serve as liaison between the government and those institutions within the province that are offering teacher education. His duties include the direction and coordination of teacher education on a provincial level.

The chief sources of information have been official documents available from the various provinces, annual reports of the departments of education, annual and special reports of departmental officials, and private correspondence from the deputy ministers and the coordinators of teacher education in the five provinces under particular study. This is the first study on the office per se; and therefore it must stand as a pioneer study in the field of administration of teacher education in Canada.

The following general conclusions were reached:

1. Administration of teacher education in provinces fall into three major areas of teacher education; there are pre-service and in-service education, recruitment, and certification.

2. The two aspects of teacher education, pre-service and in-service, are being regarded by most of the provincial coordinators as one continuous process. Most emphasis in this direction has been reported in the provinces of Saskatchewan, Alberta, and Ontario through extension departments of the teachers' colleges, teachers' study groups, and workshops for evaluation of the common school program, classroom teachers' association, and principals' associations. In many of these activities, the coordinator serves as consultant with the superintendents of schools in the various districts.

3. Recruitment of teachers has received special emphasis by the coordinators of teacher education in the provinces of New Brunswick and British Columbia. Some of the organized procedures in the recruitment programs are:

(1) public addresses by the coordinators in schools and univerisities;

(2) personal interviews with prospective students;

(3) news bulletins mailed to prospective students from the teacher education institutions and containing professional news including news of professional activities of recent graduates;

(4) more generous financial loans, fee payments, and bursaries to student teachers.

4. Certification policies and practices present critical problems for all five provinces. The differences in the certification practices appear to reflect provincial administrative assignment of responsibility rather than basic divergent views on essential requirements to be met by candidates for certification.

5. The dearth of material on the history of Canadian education is severe. Much appears to be occurring in the field, but little is being done to make available to educators any authentic records and histories other than the factual reports and documents of the provincial departments of education. This is a fertile field for research and study.
150 pages. $2.00

AN APPRAISAL OF THE ADULT EDUCATION PROGRAM OF THE HIGHLAND PARK PUBLIC SCHOOLS, HIGHLAND PARK, MICHIGAN

(L. C. Card No. Mic 58-1187)

Sophie Veronica Cheskie, Ed.D.
Wayne State University, 1957

Supervisor: Dr. William Reitz

For many years the community of Highland Park has supported an adult education program in its public schools. This program has expanded rapidly in terms of the growing needs of a changing population. Because of this rapid growth, it has become increasingly necessary to appraise the efficiency of the program in meeting current needs,

and to make recommendations for further program development.

Data for the study were obtained from two primary sources; namely, the study body of the 1957 winter term and selected community leaders. A total of 2,096 questionnaires were administered to the adult school population. Of this total, 116 were not returned and 88 had to be discarded because of incomplete answers. A random sample of every other one was taken of the remaining 1,892 questionnaires. The final sample represented 946 completed instruments. The data received were processed and summarized by the International Business Machines system.

The questionnaire was constructed so as to obtain definite data relative to personal information of the participants. In addition, questions were asked about various aspects of the adult education program. The summary of these data and the interpretation of the relationships constituted a major part of the study. For supplementary information, personal interviews were conducted with twenty-two community leaders during the same period in which the questionnaires were administered.

A review of the major conclusions of the study is now presented:

1. There exists a preference and a uniform acceptance, among all groups of students, for two generalized types of counseling services; namely, "over the counter" and "informational" counseling.
2. The most popular reasons for enrolling in adult education classes are "vocational," "cultural," "educational," and "social."
3. Students are presently enrolled in the following subject areas: "general academic," "business and commercial," "homemaking," and "leisure-time" activities.
4. Presently enrolled students indicate that their future enrollment will be concentrated in the following subject areas: "general academic," "business and commercial," and "homemaking."
5. Presently enrolled students expressed satisfaction with the services and curricular offerings of the adult education program.
6. The adult education program is evaluated as meeting adequately the present needs of the community but must expand the present course offerings into more sequential levels of work.
7. The quality of instruction in all areas is appraised as excellent.
8. The curricular offerings are conceived of as having wide variety of informal classes but as lacking in diversification in the formal and academic areas.
9. The administrative leadership of the program is thought of as commendable.
10. There should be a gradual expansion of the guidance and counseling services to reach a larger proportion of the adult education membership.
11. There should be further investigation regarding the need for extending the present program for persons wishing to complete elementary education.
12. There should be continued investigation with reference to the role of adult education in the community college concept.
13. There should be continued efforts to articulate the philosophy and importance of adult education not only to faculty but to all leaders in the community.
14. There should be a continuously improving program of public relations concerning adult education in the community.
15. There should be continuous improvement in the physical facilities, equipment, and environmental study conditions for the adult learner.
16. There should be improved and increased parking facilities for the future.
17. There should be a study of other adult education programs in the state of Michigan using the same methodological approach as this study so as to obtain more generality of findings for adult education in the state of Michigan. 534 pages. $6.80

THE DEVELOPMENT OF CRITERIA FOR EVALUATING CURRICULUM LABORATORIES IN TEACHER EDUCATION INSTITUTIONS

(Publication No. 24,373)

John Gideon Church, Ph.D.
University of Utah, 1957

Chairman: W. Donald Brumbaugh

Although curriculum laboratories[1] had developed in teacher education institutions, there were no criteria for their evaluation.

I. THE PROBLEM

Statement of the Problem

The problem was to develop criteria for evaluating the organization and administration of curriculum laboratories in teacher education institutions.

Methods of Procedure

A tentative set of criteria, based on research and the well established Evaluative Criteria[2] were applied, judged by curriculum laboratory directors, revised, judged for value as criteria another three times with revisions after each appraisal, applied and then judged, and finally applied to three curriculum laboratories by groups of educators whose individual responses were compared to find the degree of reliability of the criteria in application.

II. FINDINGS

The following were some of the findings:

1. The Majority of the eighteen judges who had applied the criteria singly to their own curriculum laboratories rated each criterion as above average in value.
2. In 80.8 per cent of their responses these judges rated the criteria as "good," "very good," or "excellent."

3. When the numbers of individual criteria upon which the responses of all the evaluators of each of the three laboratories (to which the final set of criteria was applied) were tallied, agreement was revealed in 70.9 per cent of their responses concerning positive degrees of adequacy in general.

III. CONCLUSIONS

The following were some of the conclusions:

1. The criteria had reasonable validity[3] based upon a high percentage of agreement among responses.
2. The criteria had a justifiable degree of reliability based upon a high percentage of agreement among the ratings made by evaluators in each of three curriculum laboratories.
3. The final set of criteria was acceptable for the evaluation of the organization and administration of curriculum laboratories in teacher education institutions.

IV. RECOMMENDATIONS

Reflecting the findings from original research, the following were recommended:

1. Research projects should be conducted to further refine the criteria.
2. The criteria as developed should be revised after the further development of curriculum laboratories, which at the time of the present study were generally in an embryonic stage. 244 pages. $3.15. Mic 58-4808

1. A curriculum laboratory was defined as an organization with staff, facilities, and materials for the study, planning, and construction of curricular materials.
2. Cooperative Study of Secondary School Standards, Evaluative Criteria, Section F (Washington, D.C.: Cooperative Study of Secondary School Standards, 1950), p. 207-218.
3. Reasonable validity was defined as the quality of being acceptable to good judgment, as in the case of a criterion that has been considered adequate to lead to germane evaluations of a curriculum laboratory.

A STUDY OF THE CONCEPTS OF THE COMMUNITY COLLEGE HELD BY SELECTED MICHIGAN EDUCATORS

(L. C. Card No. Mic 58-913)

Gerrit Henry Fletcher, Ed.D.
University of Michigan, 1957

The Problem

This study is an inquiry into the nature of the concept of the community college held by selected Michigan educators. It assumes that concepts held by Michigan educators are guides to understanding policies in post-high-school education they may be expected to advocate.

Research Design

A questionnaire listing elements of community college functions was mailed to one thousand ninety four leaders in public education in Michigan and to fifty leaders in post-high-school education elsewhere in the United States. Completed responses were received from seven hundred thirty eight Michigan and forty one national educators. The national jury of educators included twenty four professors of education, nine consultants to community colleges, four presidents of junior colleges, and four deans of schools of education. Their responses form a statement of an emerging concept of the community college that is developing in the nation. The Michigan educators included three hundred sixty superintendents of schools, sixty three county superintendents of schools, twenty six officers and members of the Michigan Education Association, one hundred five members of community college staffs, one hundred twelve members of state college and university staffs, and seventy two members of state boards and agencies. Their responses form a statement of the concept of the community college held by them. Comparison of their statement with the national jury judgment revealed any divergence between the views held by the two groups of educators.

Findings and Conclusion

The major findings of the study are:

1. The national jury considers a community college to be a multi-purpose institution offering less than four-year programs of instruction in college-parallel, terminal, and continuing education.

2. The national jury supports provision of cooperatively planned and community-oriented programs of service that include sponsorship of community activities, offering of college facilities for community use, and encouragement of community organizations as part of the college's role as a community cultural center.

3. Selected Michigan educators support the community college as a local public school institution offering two-year programs of instruction in college-parallel subjects and give less support to provision of terminal and continuing education. Michigan educators involved in the study give less than majority support to provision by community colleges of programs of community service.

4. Among Michigan educators, strongest support for terminal and continuing education and community services comes from members of state agencies. Least support for these programs comes from superintendents of schools. Community college and college and university staffs generally are in agreement in stronger than a majority support of these programs.

5. Michigan community colleges offer more college-parallel than terminal and continuing education courses and graduate more students from college-parallel than from terminal curriculums. The colleges generally are not involved in extensive programs of community services.

The major conclusion of the study is that Michigan educators accept a more limited role for the community college, particularly in provision of terminal and continuing education and community services, than that supported by a national jury of educators. It may be expected that Michigan educators would advocate post-high-school education more nearly resembling a traditional junior college than the emerging concept held by national educators. 263 pages. $3.40

THE CURRICULUM OF CLARKSVILLE HIGH SCHOOL, CLARKSVILLE, TENNESSEE, FROM 1944 TO 1954

(Publication No. 24,480)

James O. Knuckles, Ed.D.
George Peabody College for Teachers, 1957

Major Professor: Erick L. Lindman

Purpose of the Study

The purpose of the study was to evaluate the curriculum at Clarksville High School from 1944 to 1954. This was accomplised through:

1. A survey of the Classes of 1948, 1951, and 1954
2. A survey of parents of the students
3. Interviews with local teachers, local employers, and selected community leaders
4. Collection, tabulation, and analysis of data
5. Development of a set of evaluative criteria through an examination of professional educational literature
6. Evaluation of the effectiveness of the curriculum in light of these criteria
7. Identification of implications for program improvement

Scope

The study was limited to an analysis of opinions of former students, parents, local teachers, local employers, and community leaders. The study was further limited to Clarksville High School, Clarksville, Tennessee.

Source of Data

Information was secured from 309 former students, 180 parents, 15 high school teachers, 25 college teachers, 31 local employers, and 35 community leaders.

Procedure

An instrument was developed and used as both a questionnaire and an interview guide. The instrument was designed to reveal the strengths, weaknesses, and suggestions for improvement of the curriculum through the free responses of participants. A second part of the questionnaire was structured to reveal the degree of satisfaction to which Clarksville High School met each of the commonly accepted needs of youth. Data were tabulated and analyses were made. Evaluative criteria were developed through an examination of several major sets of objectives of public education. Conclusions were drawn and recommendations were made in keeping with the analysis and the criteria.

Findings of the Study

The data tabulated from the free response section of the questionnaire and the ratings by the respondents relative to the satisfactory degree to which Clarksville High School met each of the educational needs of youth resulted in a list of satisfactory and unsatisfactory areas of the curriculum. The respondents rated the High School's efforts to meet the educational needs of youth as satisfactory in the following areas: health education, citizenship education, human relations, student activity program, library services, and school plant.

Similarly, the following areas of the curriculum were identified as unsatisfactory: vocational education, marriage and family life education, economics and consumer education, science education, appreciation of the fine arts, wise use of leisure time, critical thinking and communicative skills, guidance services, staff personnel, and the over-all college preparatory program.

Recommendations

Conclusions were drawn in each of the above areas, and recommendations were made in the areas of personnel and curriculum. The implied weaknesses of personnel as well as the direct identification of such weaknesses dictated the following recommendations:

1. Improve staff personnel through procurement or in-service education
2. Develop a salary schedule that will attract, retain and reward competent teachers
3. Establish a policy that will up-grade competent teachers, improve weak teachers, and eliminate incompetent teachers

Identification of weaknesses of the curriculum by the respondents dictated the following recommendations:

1. Restate philosophy of education and general objectives in each instructional area
2. Consider the advisability of a dual-track curriculum for college preparatory students and vocational (terminal) students
3. Broaden curricular offerings to include general art, history and appreciation of both art and music, marriage and family life education, economics and consumer education, and applied mathematics
4. Increase scope of guidance services
5. Evaluate extra-curricular activities to secure appropriate balance
6. Consider advisability of setting up lay-school advisory committees
7. Encourage staff personnel to continue current program of curriculum improvement

186 pages. $2.45. Mic 58-4809

A STUDY OF THE INTERPERSONAL ROLE PERCEPTIONS OF SCHOOL ADMINISTRATORS, BOARD OF EDUCATION MEMBERS, AND MEMBERS OF LAY CITIZENS COMMITTEES IN MICHIGAN PUBLIC SCHOOLS

(L. C. Card No. Mic 58-945)

Charles Frederick Lehmann, Ph.D.
University of Michigan, 1957

The two general purposes of this study are: (1) to examine perceptual relationships which exist among the three major participants in the school-related lay advisory committee process, the superintendent of schools, the members of the board of education, and the members of the citizens committee; and (2) to determine possible relationships between the perceptions of the participants and the success of the committees.

The data for the study were elicited by interview as a part of the survey conducted for the Citizens Committees Research Project carried on at the University of Michigan from January, 1953, to December, 1956. Thirty communities were selected by random number from Michigan communities having school-related citizens committees. The superintendent of schools was interviewed in each case; sixty-two board of education members and ninety-three citizens committee members were interviewed.

In the first part of the study, the responses for superintendents, board of education members, and citizens committee members are analyzed in terms of the percentage of the total response for each particular questionnaire item. The statistical procedure employed for analysis of the data is chi-square. A significant finding of the study is that despite the influence of diverse factors, such as the superintendent's own perceptions of his role, the various abilities and personalities of the superintendents in the study, the diversity of the tasks which the committees themselves undertook, and the relative success or lack of success with which the committee fulfilled its goals, the superintendent is favorably regarded by more than 90% of all other participants in the advisory process. In all three sample groups, more than 77% of the respondents feel that the board of education could not have worked more effectively with the citizens committee. The perception of 94% of all three sample groups is that the board of education values the work of the citizens committee highly.

In the second part of the study, the Pearson Product Moment Correlation Coefficient was used to assess the possible relationships between various factors in the operation of citizens committees and an index of the success of citizens committees.

The perception of the superintendent's working effectiveness with the committee has a correlation of .450 with success which is significant at better than the 5 per cent level. Where elements of the perception of effectiveness are spelled out, they include: tactfulness, willingness to devote time, free contribution of suggestions and sincere cooperation.

The more favorable the perception of the board of education by the people in the community, the higher the level of success for the committee. The correlation produced on this variable (.499) is significant at better than the 5% level. In general, where there is greater knowledge about the work of the citizens committee on the part of the community, the higher may be the expected level of success of the committee. This correlation (.656) is at better than a 1% level of significance.

Three general conclusions can be drawn from the study:

1. Where school administrators and boards of education can work with citizens committees in ways which produce favorable perceptions of their effectiveness on the part of the members of the citizens committees, the chances for success of the committee are increased.

2. A strong relationship exists between success and the knowledge which a community has of the work of the citizens committee.

3. More precision is needed in the definition of roles for the board of education, the school administrator, and the members of the citizens committee.

162 pages. $2.15

THE NURSE IN THE SCHOOL HEALTH SERVICES PROGRAM: IMPLICATIONS FOR DETROIT PRACTICES

(L. C. Card No. Mic 58-1181)

Robert R. Luby, Ed.D.
Wayne State University, 1957

Supervisor: Dr. Charles L. Boye

Purpose of the Study

A basic essential for effective relationships between members of the school health team is an understanding of the role of each of the professionals involved. To understand the professional role of a key member of this team, the public health nurse serving the school, is the major purpose of this study.

Design of the Study

The design of this study included three separate phases:

1. A review of history and related literature established the development of the role of the nurse in the school and delineated currently recommended responsibilities and practices.

2. A study of annual reports and related literature provided a description of the nurse in the health service programs of Chicago, Los Angeles, New York, Philadelphia, and Detroit.

3. A questionnaire administered to the total staff of generalized public health nurses in Detroit assigned to school health services revealed the nurse's perception of certain relationships and practices in her schools.

Summary and Conclusions

Major trends identified by the review of literature and the survey of cities in this study include the following:

1. The increased responsibilities of school administrators and teachers in health services emphasizes the function of the nurse as advisor and consultant.

2. School health services involve more than the discovery of defects. There is a new emphasis being placed upon the health promotion of all children in the school.

3. The nurse making a contribution to the mental hygiene program of schools.

4. Essential tools in health appraisal of pupils are:

   a. Alert daily observation of children by classroom teachers;

   b. Planned teacher-nurse conferences;

   c. Periodic screening of children for vision and hearing by technicians other than nurse or teacher;

   d. Cumulative pupil health records;

   e. Periodic medical examinations.

5. There is increased emphasis on school health program development at the local school level which is strengthening the function of the nurse. Administrative techniques employed for this include:

   a. Central office school health consultants;

b. Designated school health coordinators in each building;

c. Health councils and committees (nurse membership);

d. Reports and records which provide insight into and evaluation of individual school health programs;

e. Workshops and in-service training institutes involving participation of school, medical, and nursing personnel.

The generalized program of public health nursing service employed in Detroit received strong support in the literature. The philosophy and pattern of school health services in which the nurse functions in Detroit was likewise well documented.

Analysis of the program of school nursing and school health services revealed the following national trends not reflected in Detroit practice:

1. The planned teacher-nurse conference for pupil health appraisal and referral.

2. Cumulative health records which present a detailed picture of pupil health status.

3. Employment of school health specialists or consultants for program by Board of Education central office. Designation of coordinators at local school level.

4. Widespread use of school health councils and committees.

5. Sponsoring of multidiscipline workshops and institutes for purpose of school health program orientation and development.

Major questionnaire findings indicate: (1) that many schools do not provide for orientation by the nurse for screening and health observation; (2) the majority of schools do not comprehensively set health goals or provide for evaluating this program; (3) many children whose needs could be handled in the classroom are sent to the nurse; (4) although most schools are warm and friendly toward the nurse, nurses feel that school personnel seems little informed about the professional status and role of the public health nurse. 332 pages. $4.25

A COST ANALYSIS OF SCHOOL BUS TRANSPORTATION IN MICHIGAN

(L. C. Card No. Mic 58-1434)

William Howard Medlyn, Ph.D.
University of Michigan, 1957

This study is a cost analysis of school bus transportation in the state of Michigan. The study was undertaken in order to:

1. Determine the average costs of pupil transportation.

2. Determine some of the major factors, some controllable and others uncontrollable, which influence the cost of transportation.

Two hundred eighteen school districts were selected for the study sample. The sample was selected from a total of 904 school districts reporting transportation costs for the school year 1952-53. The sample was selected by using a random-sample table to determine the specific school districts to be included in the study. The data used were obtained from reports submitted to the Michigan Department of Public Instruction.

Two major categories of cost were studied:

1. The individual cost items related to transportation.

2. Those factors which the writer believed to have a measurable effect on these costs.

The individual cost items studied are listed below in rank order of their importance to total cost of transportation. Also given is the average percentage of total cost for each item.

1.	Drivers' salaries	42.2 percent
2.	Depreciation	27.8
3.	Gasoline	11.8
4.	Mechanics' salaries	8.5
5.	Repair parts (private garage)	4.8
6.	Labor (private garage)	4.7
7.	Insurance	4.1
8.	Storage	4.0
9.	Interest charges	4.0
10.	Other supplies (school garage)	3.3
11.	Other salaries	2.8
12.	Tires	2.8
13.	School garage operation	2.6
14.	Oil and lubrication	0.6
15.	Driver training	0.4

The cost per pupil of transportation ranged from a low of $18 per pupil to a high of $154. Because of this wide range of cost, the pupil is not a good indicator for any type of cost prediction.

The cost per mile ranged from a low of $0.18 to a high of $0.99. Again, this item would not be a good indicator for prediction of costs for a school district.

In addition to the cost items, the study attempted to define those factors which tended to make for a variance in costs between school districts. The individual factors studied and the conclusions reached are as follows:

1. The relationship between the lineal density of pupil population and per-pupil costs indicated a coefficient of correlation of -.785 with per-pupil cost. This factor has the potential for cost-prediction purposes for local districts and for state administration of state aid.

2. The other major factor which was indicative of the cost relationship involved in the transportation of children was that of the utilization of the vehicles. The coefficient of correlation between the cost per pupil and the average number of pupils transported per bus was -.879. While this factor does indicate a relatively high coefficient, it is not practical to use for predictive purposes because it is a condition which districts cannot control.

3. The analysis of the relationship between the number of vehicles in a fleet and the average cost per vehicle yielded a coefficient of correlation of -.065. Large fleets do not appear to enjoy any cost advantage over the small fleets.

4. The relationship between the mileage traveled and the cost per mile indicated a coefficient of correlation of -.109. Districts which operated busses over the greater number of miles did not have any cost advantages over the smaller types of districts which operated busses fewer miles.

5. The cost analysis of the effect of road surfaces on the cost per mile of operation did not indicate sufficient

variance to conclude that there was a cost differential for operating over different road surfaces. 143 pages. $2.00

CONSULTANT SERVICES FURNISHED TO SUPERINTENDENTS OF SCHOOLS BY NINE STATE UNIVERSITIES AND LAND GRANT COLLEGES IN THE MIDWEST

(L. C. Card No. Mic 58-966)

Earl Eugene Mosier, Ph.D.
University of Michigan, 1957

This study is an analysis of the nature and scope of consultant services provided by 185 individuals identified with Indiana University, Michigan State College of Agriculture and Applied Science (now Michigan State University of Agriculture and Applied Science), Ohio State University, Purdue University, The State University of Iowa, University of Illinois, University of Michigan, University of Minnesota, and University of Wisconsin.

The term, "consultant," refers to an individual who was judged to possess special knowledge, skills, and experience and who provided face-to-face advisory service in an off-campus situation to at least one superintendent of schools from January 1, 1950 to January 1, 1951.

The assumptions shown on the last page of this statement lent direction to this inquiry, and upon them conclusions are based.

Both written and oral data were gathered: the former by means of an Inventory of Consultant Services; and the latter, by an Interview Schedule, supplemented by another form entitled "Supplementary Information to the Interview" on which the person interviewed recorded his judgments of the services which he had given and certain facts about his professional background and academic status. All told, 208 individuals were interviewed, of whom 185 were judged to meet the qualifications mentioned above.

Wherever it was deemed appropriate, two statistical procedures were predominantly applied to the data: the chi square test of significance and the rank correlation of relationship.

The following results emerged:

First Assumption

There is a substantial relationship between the background and status of the consultants and the services they performed as revealed by the following indices: (1) rank, (2) educational experience, (3) teaching load, (4) chairmanships of doctoral committees, and (5) criteria for furnishing such services.

Rank	Sustained.
Experience	Sustained.
Teaching load	Not sustained.
Chairmanships	Sustained.
Criteria	Sustained.

Second Assumption

There is little relationship between background and status and such factors as (1) nature of educational problems studied, (2) restriction of service to consultants' respective fields of specialization, and (3) length of consultants' educational experience.

Nature of problems	Sustained.
Fields of specialization	Sustained.
Educational experience	Sustained.

Third Assumption

There is a direct relationship between consultant services and follow-up as measured by the following types of evidence: (1) nature of planning, (2) teaching load, (3) team approach, or cooperative relations among consultants, and (4) nature of educational problems studied.

Nature of planning	Sustained.
Teaching load	Not sustained.
Team appraoch	Sustained
Nature of problems	Not sustained.

Fourth Assumption

Little if any relationship exists between follow-up and the cost of consultant services.

This assumption is not sustained.

It is proposed that these further inquiries be made.

1. A more detailed study of ways and means for coordinating planning for and following up field services requested by school executives. One aspect of this situation is the effective screening of such requests.
2. The clarification of the question of who should assume the costs of consultative services and the effect of such clarification upon the availability and extent of such services.
3. The demands made upon "quality" faculty members for field services in relation to the problem of how such requests for consultant services can be utilized for research or for other purposes valuable to the university or to the state.
4. The results of consultant services to local school systems. Evaluations of this character could contribute materially to the improvement of such services.
5. The determination of the significance of the departures from the proved assumption that consultative services are restricted to the consultants' respective fields of specialization. 133 pages. $2.00

IDENTIFICATION OF FACTORS USED IN SELECTING MECHANICAL SYSTEMS FOR SCHOOL BUILDINGS

(L. C. Card No. Mic 58-1275)

John Philip Picco, Jr., Ed.D.
Stanford University, 1958

Purposes of the Investigation

A basic aspect in the consideration of the thermal environment as it affects learning is the study of the mechanical system of the school building. While there is engineering data on heating and ventilating of schools, little information is available to the educator in terms of educational specifications regarding the thermal needs of school buildings. The purposes of the study are: (1) to identify those who choose the mechanical system for school

buildings; (2) to identify the bases by which a system is chosen; (3) to analyze the procedures used in evaluating a system after it is in operation and to analyze the effect such procedures have on subsequent building projects; and (4) to enumerate those factors from which criteria may be developed for use in selecting and evaluating efficient mechanical systems for school buildings.

Methods of Procedure

Thirty-six school buildings were selected in the nine San Francisco Bay Area Counties for the analysis of their heating and ventilating equipment. Twenty-two architects and nineteen mechanical engineers were identified who had participated in the design and development of these buildings. Structured personal interviews with architects and mechanical engineers produced pertinent data for objective analysis of the factors used in the selection of the mechanical systems in these schools. In addition, unstructured interviews were held with school personnel of the subject buildings.

Summary of Findings

1. Who selects the mechanical system:--School architects generally consider the choice of mechanical system their professional prerogative. Mechanical engineers contend the selection of mechanical systems is the result of compromises involving architectural demands, adaptability of construction materials, and the designing competency of the mechanical engineer. School officials, with few exceptions, admit to little participation in selecting mechanical equipment.

2. Bases for system selection:--The architectural group identified ten factors used in selecting mechanical systems for schools in California: (1) cost; (2) building design, size, and layout; (3) room area use; (4) existing capacity of system--relative to building additions; (5) district preference; (6) current mechanical system trends; (7) manufacturer pressure; (8) mechanical engineers; (9) experimentation; and (10) California State Aid Building Program.

3. Evaluation of mechanical systems now in operation:--School architects as a group have no standards for evaluating school mechanical systems. While it is the desire of a majority of mechanical engineers to develop procedures for evaluating school mechanical systems, systematic evaluation seldom takes place. School official evaluation is largely impressionistic.

4. Enumeration of fundamental factors in system selection:--The following factors were identified as basic considerations involved in selecting an efficient mechanical system: (1) ability to heat; (2) ability to cool; (3) ability to ventilate; (4) adaptability of system; (5) simplicity of system; (6) flexibility of system; (7) safety; (8) initial cost; (9) operational costs; (10) maintenance requirements; (11) functionality of controls; and (12) mechanical room requirements.

Conclusions and Recommendations

1. Satisfactory selection and evaluation of mechanical systems cannot take place until specific criteria are developed. The general areas in which criteria are needed are those enumerated in the preceding paragraph.

Since their development will require cooperative efforts of technicians and school administrators, representatives of the architectural, mechanical engineering, and educational professions together with the California State Department of Education should develop criteria from the identified factors.

2. Those architects and mechanical engineers responsible for the designing and developing school mechanical systems do little evaluating of these systems once they have been placed in operation.

Architects, mechanical engineers, together with school planning officials should establish standards of performance for school mechanical systems before regulatory agencies impose rigid standards for school installations.

3. No single type of mechanical system now in use has proved entirely satisfactory in fulfilling the thermal needs of the physical environment of the school building.

These needs should be specifically identified through experimental research by mechanical engineers and manufactureres in efforts to develop a mechanical system for school buildings.

4. Many architects resent preconceived design expectations of school officials and many school officials are suspicious of architects questioning their conclusions regarding the educational needs for school buildings.

Representatives from both groups should devise school planning procedures for mutual understanding.

249 pages. $3.25

AN INVESTIGATION OF THE DEGREE OF UNDERSTANDING OF MEANINGS IN ARITHMETIC OF PUPILS IN SELECTED ELEMENTARY SCHOOLS

(Publication No. 24,938)

David Rappaport, Ed.D.
Northwestern University, 1957

Purpose of study. This study was undertaken for the purpose of determining the degree of children's understanding of basic concepts and processes of arithmetic that they used in their computations. It also investigated the relationship between computational skill and the understanding of a group of basic meanings assumed to be inherent in arithmetic.

Design of study. The California Arithmetic Test, Intermediate Form, for Grades 7-8-9, was administered to 271 7B pupils in nine public elementary schools on the North side of Chicago and to 110 8B pupils in three of the nine schools. This standardized test was used in order to determine the computation skills achieved by the children participating in the study. The children were separated into three groups, high, average, and low, based on the scores on this test.

An Experimental Test was devised for the purpose of measuring the understanding of the basic meanings in arithmetic. This test contained 72 items that tested the understanding of sixteen basic concepts and operations that were derived from the number system itself.

The scores on the two tests were correlated for each group as a whole and for each of the three groups designated as high, average, and low.

The items following each abstract are: the number of manuscript pages in the dissertation, its cost on microfilm, and the Library of Congress card number. Enlargements 5-1/2 x 8-1/2 inches, 4 cents per page. No postage is charged if check or money order accompanies order.

Findings.

1. The mean score on the California Arithmetic Test was 51.87 and the standard deviation was 14.85 for the Seventh Grade. The mean score was 62.12 and the standard deviation was 12.29 for the Eighth Grade.
2. The mean score and standard deviation on the Experimental Test were 26.98 and 11.90 for the Seventh Grade and 30.42 and 12.50 for the Eighth Grade.
3. 79 percent of the Seventh Graders and 74 percent of the Eighth Graders achieved less than 50 percent of the Meanings Test.
4. The coefficients of correlation between the computation and meanings tests for the Seventh and Eighth Grades, respectively, were:
   (a) .63 and .63 for the group as a whole
   (b) .54 and .19 for the high group
   (c) .39 and .40 for the average group
   (d) .31 and .18 for the low group.

Conclusions. The following conclusions were drawn:

1. The Seventh and Eighth Grade pupils did not have an adequate understanding of the meanings in arithmetic.
2. Computational skill was not an indication of understanding of the meanings of the processes used in the computation.
3. Pupils with high achievement in computation could have low achievement on a meanings test, but there were no pupils with high achievement on meanings but low achievement in computational skill.
4. The pupils tended to follow mechanical processes rather than meaningful interpretations in doing their arithmetic exercises.
5. Pupils showed a greater concern over the derivation of answers to arithmetical exercises than in understanding the meanings in arithmetic.

Recommendations to teachers and school administrators.

1. Teachers and school administrators should state clearly and interpret in their course of study, outlines, or curriculum guides the list of meanings in arithmetic that they want the pupils to learn.
2. Teachers should examine their own understanding of the basic meanings in arithmetic.
3. Teachers should show more concern for the thought processes involved in the solution of arithmetic problems.
4. Teachers should motivate, stimulate, and create a learning atmosphere in which pupils discover for themselves the meanings in arithmetic.
5. Teachers should refrain from premature or initial reliance on drill as a method of teaching.
6. School administrators and teachers should not be satisfied with the mere development of computational skills but should stress meaningful understanding.
7. Teachers in all grades, but especially the primary grade teachers, should go slowly and not rush to the abstract levels of arithmetic too soon.

169 pages. $2.25. Mic 58-4810

QUANTITATIVE ANALYSIS OF EXPERIMENTAL EFFORTS TO CHANGE ADOLESCENT ATTITUDES THROUGH A COURSE IN "INTERPERSONAL RELATIONS"

(L. C. Card No. Mic 58-1190)

Richard H. Schell, Ed.D.
Wayne State University, 1957

Supervisor: Dr. Mildred Peters

In certain areas of a large midwestern city an increasing rate of gonorrheal infection and illegitimate birth rates among adolescents gives evidence of serious breakdown of adequate family life and training.

A committee composed of teachers, administrators, parents and interested professional people spent considerable time in seeking means for alleviating the problem. One approach which the committee determined might be feasible was the offering of a course especially designed to help youth build wholesome attitudes with regard to the family, boy and girl relationships, self-understanding, and life's problems.

The purpose of this study was to evaluate the effectiveness of that sixteen weeks course, "Interpersonal Relations" in improving the personal and social adjustment of adolescent school children. Improvement in the areas cited was to be reflected by positive changes in the subjects' attitudes toward their family, peers, and school. It was also predicted that boys and girls who completed the course would perceive it and their teachers as more adequate than they had originally.

Boys and girls entering the 9B grade were offered the experimental course. Their selection had been determined primarily because of the increasing rates of reported venereal disease and illegitimate pregnancy cases among the school's student population. Students at this grade level were included because of the beneficial preventive effects which might be realized for these younger students.

There were ninety-seven girls and forty-eight boys or a total of 145 students who enrolled for the course. These students comprised the Experimental group. In another school the 9B class numbered ninety-two girls and fifty boys or a total of 142 students. These students were considered comparable to the Experimental group and formed the Control group. The Control group members were all enrolled in a course in History. Four data gathering instruments were utilized in both a pre and post test situation, namely: "California Test of Personality" (Secondary Form) 1953 Revision; a "Questionnaire for Parents"; "Pre-Course Questionnaire" and "Post Course Evaluation"; and a "Student Attitude Form" all excepting the first being original forms.

All data yielded from the original forms were quantified. Since it was then possible to determine mean scores for all cases, it was considered desirable to employ a statistical technique which was capable of determining the

significant difference between two uncorrelated means. The t-test, therefore, was utilized in the statistical analysis of the study. This technique enabled the writer to determine if there was a difference between the Control and Experimental or the Pre and Post test groups. At the same time, it was important to determine in which group's favor the difference existed.

For the most part, findings were not statistically significant with the exception of Teacher Adequacy. In this instance the Experimental group's mean scores were statistically significant for three of the four syndromes, which subdivided the category. There were a number of other instances, however, where the data yielded were regarded as being statistically inconclusive.

It may be stated that the course, "Interpersonal Relations" did not achieve its purpose as measured by the data gathering instruments and the experimental design which was employed.

On the other hand, it may well be that the course actually contributed substantially to the welfare of the students in areas other than those considered within the limitations of this study. A number of implications for further research are noted in the final chapter.

Regardless, the parents, school teachers and administrators, members of the Commission on Children and Youth, church and professional representatives are all to be commended for their substantial efforts to seek a solution to a serious problem which is threatening our teenage youth. 233 pages. $3.05

RELATIONSHIP OF HIGH SCHOOL SIZE TO STAFF RELATIONS

(L. C. Card No. Mic 58-1277)

David Franklin Shapiro, Ed.D.
Stanford University, 1958

PROBLEM

Since World War II an increasing number of communities with only one high school have needed to consider the addition of one or more new high schools. In the planning for these schools, secondary educators have been asked to recommend the size of high school which would best meet the needs of the youth and the community.

Since the factors related to the size of a high school are numerous and could not be adequately examined in one study, four co-operative studies were undertaken to determine the relationship of high school size to curricular offering, guidance, staff relations, and school community relations. The concern of this study was with the staff relations.

PROCEDURES

Seventeen four year high schools in the Bay Area of California, whose enrollments were greater than 800, participated in the co-operative study. Four questionnaires, each of which contained items pertinent to the area of staff relations, were administered to samplings of different populations within these four year high schools ranging in size from 800 to 2000 plus. The samplings included ten per cent of the parents of high school students, all administrative officers working within the school, fifty per cent of the teachers, and ten per cent of the students.

The seventeen schools were divided into four categories according to size 800 to 1199, 1200 to 1599, 1600 to 1999, and 2000 and above. Two types of analyses were made: (1) a Chi square test was used to determine any significant differences in responses to each of the items in the questionnaires among the schools of a particular size category; and (2) the test for significance of difference of per cent was used to determine if there were significant differences in responses among the schools of different size categories.

The data were collected and analyzed to determine if there were any relationships between size of high school and the six factors related to staff relations (1) Communication, (2) Group Cooperation, (3) Teacher Effectiveness, (4) Staff Participation, (5) Supervision, (6) Teacher Load and Routines.

RESULTS

1. Communications were more effective in smaller schools than in the larger schools.
2. More effective group co-operation was evidenced in smaller schools than in the larger schools.
3. The individual members of the staff performed more effectively in the smaller schools than in the larger schools.
4. There was very little difference, if any, in the actual staff participation in the administration of the school, in all of the various sized schools.
5. Supervision was more effective in the schools with enrollments between 1200 and 1600 than in the other three size categories.
6. There was little difference in the reports of the average total hours spent on the job, between staff of smaller or larger sized schools. However, the kinds of activities assigned staff members of smaller schools were more meaningful to them than were those assigned to staff members in the larger schools.

CONCLUSIONS

Based on the limited scope and sample of this study, the optimum size school for staff relations is one with an enrollment between 1200 and 1600. However, the conditions favoring staff relations in one size high school over another are not great enough to warrant major sacrifices in achieving a specific size. 236 pages. $3.05

EDUCATION, ADULT

A STUDY OF MEMBER CREDIT UNIONS OF THE MICHIGAN CREDIT UNION LEAGUE RELATING PARTICIPATION, COHESIVENESS, UNIFORMITY OF OPINIONS AND ATTITUDES, AND OTHER FACTORS TO CREDIT UNION SUCCESS

(L. C. Card No. Mic 58-926)

John Babcock Hawley, Ph.D.
University of Michigan, 1957

The study is designed to develop an index of credit union success, to select two groups of more and less

successful credit unions in accordance with it, and then to examine the differences between these two groups. The credit unions involved in this study are members of the Michigan Credit Union League.

Criteria for judging credit union effectiveness, economic and otherwise, are isolated after study of credit union literature and conferences with credit union leaders. The most important of these criteria, selected by a qualified group of experts, are examined. An index of credit union success composed of six items is developed: (1) the ratio of actual to potential members, (2) the ratio of borrowers to members, (3) the ratio of expenses to income, (4) the ratio of net earnings to shares, (5) the average size share to optimum size share, and (6) the ratio of the number of delinquent loans to total number of loans outstanding. The index is validated by correlating the global judgments by a group of credit union authorities and the index's rating of forty-three credit unions. Statistical analysis, using a Pearson coefficient of correlation, reveals a positive relationship. Ten more successful and ten less successful credit unions are selected for further investigation in accordance with the index.

Differences between the two groups are examined in two areas: (1) other important criteria of success relating to the organizational aspects of credit unions as well as the personal characteristics of their leaders, and (2) investigation of the leaders of the two groups with respect to four dynamic variables: (a) group participation, (b) group cohesiveness, (c) uniformity of attitudes and opinions, and (d) authoritarianism.

More successful credit unions appear to have more liberal lending policies and practices. The conduct almost twice as many credit committee meetings as do the less successful groups. Leaders of the more successful credit unions generally have been associated with the credit union movement longer than the leaders of the less successful groups. More than twice as many of the leaders of the more successful than of the less successful groups subscribe to the Credit Union National Association's magazine, The Credit Union Bridge. A higher proportion of the leaders of the more successful credit unions perceive themselves as being liberal in political and social matters than do the leaders of the less successful groups.

In all measures of group participation at local, chapter, and state levels, the leaders of more successful credit unions exhibit a significantly higher degree of activity than do the less successful groups' leaders. Further, the leaders of the more successful credit unions exhibit a significantly higher degree of cohesiveness than do the leaders of the less successful credit unions. The leaders of the more successful groups also appear to express a greater uniformity of opinions and attitudes on some matters relavant to credit union affairs. Little difference between the two groups of leaders exists in the degree of authoritarianism which they exhibit.

Further study along a number of lines is recommended at several points. The data corroborate several other studies which indicate that in voluntary groups greater cohesiveness relates to higher effectiveness.

153 pages. $2.05

EDUCATION, HISTORY

DEVELOPMENT OF THE PH. D. PROGRAM IN THE UNITED STATES IN THE NINETEENTH CENTURY

(Publication No. 25,429)

Mary Vernace Bean, Ph.D.
The Ohio State University, 1953

This is an historical study. Its purpose is to trace the development of the Ph.D. program in the United States in the nineteenth century. It is intended to show how the doctor of philosophy degree was taken over from German university education and introduced into American university education. The period which the study covers is from approximately 1800 to 1900. This particular period was selected because the nineteenth century was the time of the origin of Ph.D. programs of work. By 1900 such programs had become fairly well established and standardized.

The study includes the European background from which the American Ph.D. program developed; an historical account of the exploratory period in the United States from 1800 to 1875; and the period of standardization in the United States from 1876 to 1900. Under European background the universities of Bologna and Paris are discussed.

The first of the great medieval universities was the University of Bologna, Italy. Bologna, dating from the latter part of the eleventh century, was the earliest degree-granting university. This ancestor of present-day universities was not consciously constructed according to a previously thought-out plan, but gradually evolved through decades and centuries.

The medieval university was in the beginning a guild of foreign students. It was patterned after the existing trade guilds. The term universitas which came to be applied to guilds of students was a Roman legal term practically equivalent to our modern word corporation. Historically the word university had no connection with the universality of learning. It denoted the totality of a group whether of tradespeople or students.

The earliest scholastic fame of the University arose from its instruction in the liberal arts. In medieval university language the terms doctor, master, professor, were synomyous terms. Constitutionally Bologna was a corporation or a plurality of corporations. It was an autonomous student university.

Evolving at about the same time as Bologna in Italy was the University of Paris, in France. The University at Paris, dating from about the middle of the twelfth century, developed from the guild of masters teaching at Paris. It will be remembered that Bologna evolved from the guilds of students. This position of the masters distinguishes Paris from the early Italian system. By the middle of the fourteenth century Paris was at its peak and it was after Paris that the early English universities of Oxford and Cambridge were modeled.

The university at Oxford in its primitive form may be regarded as an imitation or perhaps as a reproduction of the Parisian society of masters. Oxford University was founded early in the thirteenth century by a scholastic migration from the University of Paris; later the University of Cambridge was founded by a scholastic migration from the University of Oxford. Oxford University was a federation of corporate colleges. Each college was a unit of residence as well as of instruction. Each college had

its own administration, endowment, building, instructional staff, and course of study. The University held the examinations and conferred all degrees. It was through this function that the University exercised control over the colleges. It is this position of the college within the University which is the distinguishing mark of the English universities. The early American colleges were later founded largely by graduates of the English universities, who transplanted the form of the English college to American soil.

The German universities, as well as the English universities just described, stemmed from the same source, the University of Paris, sometimes referred to as "the mother of universities." The beginning of the modern university in Germany was marked by the establishment of the University of Halle in 1694. The modern movement instituted at Halle envolved the reform of the older German universities (which had existed since the middle of the fourteenth century), and the establishment of new ones.

The University of Berlin founded in 1809 was the first modern university in the present-day sense. With the establishment of the University of Berlin scientific investigation was placed first in importance. At Berlin, for the first time, the entire university program was built to carry out, foremost, scientific work. Excellently equipped laboratories were provided. Instruction was carried on with a view to freedom of teaching and learning.

In the seventeenth and eighteenth centuries many young men of means who desired advanced training left the United States and studied in the universities of Europe. In the early part of the nineteenth century these students were attracted largely to Germany where the first modern university had just developed. Germany became the mecca for young men seeking a complete training in the sciences and a complete university education. What these young men witnessed so far exceeded anything which they had ever known that they returned to the United States embued with the idea of putting into practice some of these ideas of German university education.

Upon returning to the United States these young men were most frequently appointed to important positions in the then small American English-patterned colleges. In attempting to develop and expand their own fields of work they made use of some of the new procedures which they had learned abroad. When it was seen what the young Americans trained in Europe could do, there was a general demand that the American colleges provide some of the benefits of the European university.

This superimposing of the elements of the modern German university on the structure of the American liberal arts college created a new institution, the American university. This process took place largely during the first three quarters of the nineteenth century. Yale, Harvard, Cornell, Michigan, and Johns Hopkins were selected for the study because it was felt that each represented a different type of leadership in the development of the Ph.D. program in the United States.

Yale is discussed first, because in providing instruction leading to the Ph.D. degree, Yale led the way. In 1841 Yale made its first provision for graduate instruction by instituting a few courses in the Semitic languages. In 1834 a further step was taken when an entire course of study for graduate students was set up in the department of Latin and Greek. In 1847 a graduate department was organized, known as the Department of Philosophy and the Arts. In 1861 this department conferred the first doctor of philosophy degree in the United States.

At Harvard, as at Yale, interest in advanced work was shown early in the nineteenth century. Since 1642 some graduates of Harvard had remained in residence after taking the bachelor's degree although no specially designed instruction for them was provided. In 1824 Professor George Ticknor, newly appointed to the faculty after several years study in Germany, recommended a number of changes. These suggested changes Ticknor considered as an opening wedge to graduate work. Two of these were the introduction of an elective system of studies in the entire university curriculum and the establishment of a new department of modern languages of French, German, and Spanish.

Had Harvard been ready to accept Ticknor's proposals the college would have gained time in its transition from a college into a university. But it was not ready to accept. So the groping for ways of bringing up a program which would attract graduate students went on. In 1860 a system of University Lectures was instituted to attract graduate students. In 1871 these were discontinued as not successfully attracting the desired enrollment. In 1872 the Ph.D. degree was first offered at Harvard and in 1873 it was first conferred.

The history of Cornell presents a sharp contrast to that of Harvard. Cornell was a univeristy designed to give instruction in the mechanical arts. Its unique contribution is that it proved that practical technical training could be offered as a highly creditable university education. Cornell offered graduate work from the beginning (1868), and to encourage attendance it charged no tuition the first twenty-four years. Although the Ph.D. had been offered since 1868, it was first conferred in 1872. Graduate work was slow in becoming established at Cornell. From 1872 to 1875, the close of this part of the study, only three Ph.D. degrees had been conferred.

The University of Michigan was a part of the public educational system of the state. In 1852 Michigan began taking those steps which transformed it into a university in practice as well as name. In this year the elective system of studies was instituted; it was intended as a means of encouraging resident graduates. In 1858 courses primarily for graduates were introduced. In 1871 the historical seminar was instituted. In 1874 the doctor of philosophy degree was first offered. In 1875 this degree was first conferred at Michigan, but as an honorary, not as an earned degree. In 1876 the first earned Ph.D. was conferred at the University of Michigan.

The way in which the Johns Hopkins University, founded in 1867, was organized was the reason for its leadership and great influence in the nineteenth century in graduate work in the United States. It was believed by its first president, Daniel Coit Gilman, that a university should place emphasis on graduate work. So Johns Hopkins was founded as primarily a graduate institution. Gilman gathered together the most magnificant faculty the United States had yet seen. The quality of students which were attracted was no less remarkable than the faculty. When Hopkins opened in 1876 it was as a full-fledged university. It offered but one higher degree, the Ph.D.

By 1875 the period of experimentation was largely over, and well-rounded programs of graduate work had begun to develop.

The period of from 1876 to 1900 was for Yale one of large unfoldment on a solid and scholarly basis. In 1887 Yale College was officially renamed Yale University. In 1889 "Courses of Graduate Instruction" were renamed the

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Graduate Department. In 1892 a dean was appointed to oversee the graduate department. In 1896 the Graduate Department was renamed the Graduate School. Throughout this quarter-century the number of graduate students had increased fivefold, from 60 to 304. The number of graduate courses expanded from approximately 75 to 353. Throughout this expansion the three main areas of specialization chosen by graduate students remained the same: political science, natural and physical sciences, and classical philology.

By 1900 Yale had had a total graduate enrollment of 2832 and had conferred a total of 283 degrees. The degree was considered to be a six year degree, two years had to be spent in study beyond the bachelor's degree. The candidate was required to pass an examination in Latin, French, and German, and a final examination on the two year course of study. The fee for graduate instruction was the same from 1876 to 1900--$100 a year. In 1900, the close of this study, Yale had an independent Graduate School with its own buildings, dean, and faculty. The School had an annual enrollment of some 300 students. Throughout its history Yale had never conferred the Ph.D. except on a highly creditable basis.

In 1900 Harvard had an organized Graduate School with an enrollment of more than 300 students and offered more than 400 courses in some thirty departments. Since 1890 Harvard had been conferring an average of about 18 Ph.D.'s annually. Candidates for this degree at Harvard largely chose the subject matter fields of the humanities, and the majority chose classical philology. Harvard's graduate students found all their instruction under the elective system of studies at the University.

From 1876 to 1900 Harvard had a total enrollment of 3481 graduate students and conferred 243 degrees. Harvard did not mention any language requirement. It undoubtedly was assumed that one who had completed the undergraduate curriculum would of necessity have a thorough knowledge of the languages. The degree was considered to be a six year degree, a two-year course of study was required beyond the bachelor's degree. There was a final examination on the two year course of study and a thesis. By 1900 graduate work was thoroughly established at Harvard and students from most parts of continental United States and from various foreign countries were enrolled.

In 1900 graduate work was well established at Cornell and was under the supervision of the University faculty with the Committee on Higher Degrees handling details. Graduate work at Cornell had attained an enrollment in 1900 of less than 175, and a total of 129 took the degree between 1876 and 1900. The leading areas in choice of the students were, history, political science, and ancient and modern languages. This is of interest since Cornell placed emphasis on technical education. Graduate work did not seem to become established so early in the state universities. Only since 1894 had Cornell charged tuition to graduates and there was as yet no graduate department or graduate school.

From 1876 to 1900 Cornell had a total graduate enrollment of 2094 and conferred 129 degrees. In spite of Cornell's emphasis on technical education it had an unusually demanding language requirement for the degree. It required three languages, Latin, German, and French. Furthermore, Cornell required three years of study beyond the bachelor's degree. This was to include one major subject and two related minor subjects. Both written and oral examinations were taken in the major and the minors. Since Cornell required three years of study beyond the bachelor's degree, the Ph.D. was a seven year degree.

The University of Michigan conferred 62 Ph.D. degrees between 1876 and 1900. Graduate work was to be found under the elective system of studies of the University. The leading fields of specialization chosen by doctorate candidates were those of history and political science. In 1900 the annual enrollment of resident graduates had just attained the 100 mark. The requirements for the degree were high; it was considered a seven year degree. Michigan conferred the Ph.D. also as an honorary degree, but discontinued this practice in 1892. Graduate work in this midwest state university was slow in expanding. There was no graduate school as an independent organization until well into the twentieth century.

From 1876 to 1900 Michigan had a total graduate enrollment of 1038. Since at Michigan three years of study beyond the bachelor's was required, the student would probably be in residence most of the three years. Therefore the figure for total enrollment would not mean an entirely new group of students annually. Michigan had the lowest enrollments in graduate work of any of the five universities included in this study. Because of these new numbers the organization of a graduate department and graduate school was delayed. Nevertheless, the requirements for the degree were high, and the earned degree was conferred on a highly creditable basis.

Johns Hopkins had a magnificant history from 1876 to 1900. By 1900 it had had a total cumulative graduate enrollment of 5945 students and had conferred a total of 590 Ph.D. degrees. The average number conferred annually during this period was 11. Graduate instruction centered in the seminar. Instructional courses were allied to the topic of the seminar. The research problem of each individual member of the seminar was related to that of every other member, and was carried on within the framework of the seminar and courses.

Considering the excellent facilities for carrying on research and the highly paid faculty, tuition at Hopkins was low. In 1876 it was $80 a year. By 1900 it had increased until it was approximately the same as the other eastern universities included in this study, $150 a year. Although instruction for the doctorate could be taken in some thirty departments the areas most frequently chosen by the candidates were history, physics, and chemistry. It was after Hopkins opened in 1876 that other universities, observing it, came to see how graduate instruction could be successfully developed. Therefore, it is to Hopkins that the greatest debt is owed for bringing graduate work to a successful high level of development at the close of the nineteenth century.

The state universities were desirous of building up a graduate enrollment, and, having this desire, Cornell charged no tuition to graduates for the first twenty-five years. The University of Michigan, being subsidized entirely by the state, kept its fees low. Considering that Johns Hopkins was considered by many to have the best facilities for graduate work, the cost was lower than might be expected. In all cases when a fee was set for graduate instruction it was set at the same figure as for undergraduate.

It was usually a year or two after the degree was first available that there was a candidate who met the requirements. In instituting a definite program leading to the Ph.D. Yale led the way. Some of the Yale graduates then

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became members of the teaching staff of the other institutions. Textbooks written by Silliman, Whitney, and Dana at Yale were used in graduate instruction in some of the other universities, thus making Yale a strong and beneficial help in the early years. By 1900 the requirements for the Ph.D. had become much the same.

The development of the Ph.D. program in the United States from the time elements were first introduced to the close of the nineteenth century constitutes one of the most interesting movements in higher education in our country. Because there is little literature on the early period of graduate education in the United States the study was undertaken. By 1900 the form which the Ph.D. was to maintain in the first half of the twentieth century was well established and standardized. 344 pages. $4.40. Mic 58-4811

Abstract published by special arrangement with The Ohio State University.

THE ORIGIN AND DEVELOPMENT OF TOWN-SCHOOL EDUCATION IN COLONIAL MASSACHUSETTS, 1635-1775

(L. C. Card No. Mic 58-1076)

Norwood Marion Cole, Ed.D.
University of Washington, 1957

Three principal themes are characteristic of the educational history of Massachusetts, 1635-1775. The period is marked by the evolution of an educational system based on an English model to the formation of the American common school. Within two decades after the settlement of the Bay colony eight (possibly nine) schools had been established. Although considerable progress had been made the Puritan leaders were not satisfied. In their opinion education was essential also for good citizenship and worldly accomplishment. Upon this basic philosophy the Puritan educational system was built.

Like their English counterpart the early schools of Massachusetts were the result of local and private initiative. By 1642, the Puritan leaders were convinced that this was not enough to provide the educational framework needed in the commonwealth. In 1642, the General Court stipulated that children should be taught to read, and enacted the famous school law of 1647. By this measure towns of fifty families were directed to establish a writing school and towns of one hundred families a grammar school. These laws are significant because for the first time education was compulsory, and became a civil function.

The English pattern of "Dame," writing, and grammar schools underwent considerable modification. Reading, writing, and arithmetic were more important than a classical curriculum to a frontier society. Therefore, when towns reached a population of one hundred families, they employed a schoolmaster to teach grammar and writing. Thus the combination grammar-writing school became the typical town-school. Furthermore, in the Eighteenth Century the town-schools assumed responsibility for primary training. By the end of the colonial period the district school, with its curriculum of the three R's, became the basis of the American common school.

Local responsibility was a second characteristics of the Massachusetts school system. The central government established the framework, but each community was responsible for its school. Regulation and provision of schools was a function of the town-meeting. In most towns the power to administer schools was delegated to the selectmen, but by the end of the period this task had been assumed by school committees, the forerunner of the modern board of school directors. Certification of schoolmasters was delegated to the selectmen in 1654. In 1701 grammar schoolmasters were to be certified by the ministers. Thus the certification of schoolmasters was assumed by civil authorities because the ministers were the only professional group capable of determining the educational qualifications of grammar masters.

Perhaps the most important development was the emergence of the free, tax supported school. Like their English counterpart, the early schools were financed by philanthropy, land grants, and tuition. By the 1650's, a few towns assumed part of the financial burden for schools; but, after 1730, the typical school was a free, tax supported institution. Development of the tax supported school idea also brought increased demands for educational facilities. During the last quarter of the Seventeenth Century the moving school emerged, and further agitation caused the various towns to subdivide into school districts in order to serve a greater proportion of the population.

The moving and district school provided more schools, but it is also apparent that by the end of the colonial period the Massachusetts school system was considerably weakened. School terms of a few months duration, and less educated instructors, were characteristic. Furthermore, after 1750, women began to assume an important role in the teaching profession. Thus a pattern of town-school education developed which remained characteristic until the reforms of Mann and Barnard during the next century. 615 pages. $7.80

THE PURPOSES OF THE AMERICAN COLONIAL COLLEGES

(L. C. Card No. Mic 58-1272)

Jerome Sanford Fink, Ed.D.
Stanford University, 1958

Despite the sparse population and frontier conditions of colonial America, nine colleges emerged between 1636 and 1776. Numerous and conflicting interpretations now abound concerning the purposes of these pre-Revolutionary colleges. Most writers follow one of three viewpoints concerning the intentions of their organizers. Group One contends that these first institutions of higher education arose solely to train ministers. Group Two holds that the colleges arose primarily though not solely to educate clergymen. Group Three argues that the preparation of preachers was but one of the many purposes of the nine colleges. The central problem of the dissertation is to evaluate the historical evidence to see which of the three interpretations appears more historically correct.

To assess the validity of each of the three schools of thought, the author has set up a series of standards whereby he examines data relating to each of the nine colleges. The purposes which the pre-Revolutionary colleges

sought to carry out seem best understood when a careful examination is made of their documents (charters and legislative acts pertaining to their foundings and their aims), statements relating to their curriculums, inspection of the actual number of their graduates who entered the ministry which the writer terms products, and an appraisal of neglected statements pertaining to the purposes of these first American institutions of higher education. The study presents findings that validate the position of Group Three, to wit, that the education of ministers was but one of the aims of America's colonial colleges.

The following findings came to light as a result of this investigation:

1. None of the documents of any of the nine colleges state that the preparation of preachers was either their sole or primary purpose.
2. The dissertation clearly shows that the curriculums of the pre-Revolutionary colleges consisted of instruction made up of the liberal arts not professional theology.
3. An examination of the occupational distribution of colonial college graduates (products) shows quite conclusively that no overwhelming preponderance of colonial college-educated men followed the sacred calling.
4. Statements as found in official college histories, colonial newspapers, and similar source material prove beyond a doubt that the training of clergymen comprised but one of the aims which these beginning colleges sought to fulfill.

The colonial colleges came into being as liberal arts colleges not as theological seminaries despite the assertions made by some writers. The aims which they sought to carry out were those of the liberal arts not the professional study of divinity. The colleges, to be sure, educated prospective preachers, but they also prepared future lawyers, teachers, physicians, and businessmen all from the same common intellectual source. The success of these early colleges can best be seen in the attainments of some of their products, namely, those men who aided in organizing thirteen disunited colonies into the United States of America - Jefferson of William and Mary, Madison of Princeton, Hamilton of Columbia, Sam Adams and John Adams both of Harvard. 224 pages. $2.90

THE RISE OF THE UNIVERSITY SCHOOL OF EDUCATION AS A PROFESSIONAL INSTITUTION

(L. C. Card No. Mic 58-1274)

Arthur Ray Partridge, Ed.D.
Stanford University, 1958

This study has been undertaken to explore the origins and development of the university school of education. Two initial premises defined the scope of the study: First, those in charge of schools of education cannot cope adequately with the problems they face unless they understand the directional forces which have led to present practices and which have created present problems. Second, the changing demands of the American people have been definitive in the training of teachers and have profoundly affected the development of teacher-training structures including the university school of education.

The investigation has focused attention on two considerations: First, the school of education's relationship to the historical continuum of American higher education and, second, its relationship to the social forces which have characterized the evolving American society during the period of its development.

The writer collected data from general histories of American education, histories of teacher education, histories of the universities whose schools of education have been the subjects of this study, and general treatises on the evolution of American society since the colonial period. Against the background of changing patterns of society and the resulting movements which have affected education at all levels, the writer traced the development of 12 university schools of education which have exerted directional influence upon the entire school of education movement.

The study also reviewed the changing demands which an increasingly industrialized society placed upon education at all levels and especially upon the public schools, demands which altered the role of the teacher and which required more thorough preparation for teachers. The evolution of American society created two conditions requisite to the establishment of schools for the professional training of practitioners: first, greater occupational specialization and, second, an accumulation of professionalized knowledge which practitioners needed to acquire.

Employing the information gathered, answers have been sought to four questions:

1. What structure have evolved? How and way has this evolution occurred?
2. What functions do these structures perform?
3. For what purposes do these structures perform these functions?
4. What is the probable future of the university school of education in terms of its historical continuum?

The histories of the twelve university schools of education which this study has investigated point to certain general characteristics of such schools:

1. They originated with people outside the universities rather than within them.
2. They share the professional training function with academic departments.
3. They define professional training as consisting of the study of educational science and the development of scholarly and philosophical insights.
4. They originally prepared high school teachers, leaving to the normal school the function of preparing elementary school teachers. Today, however, these two structures in a sense compete in the training of educationists for all levels, and the normal school evolved first into a teachers college and then into an intermediate university.

The study identified four basic issues which presently confront the university school of education, issues which really affect all American higher education: First, the nature of general education, second, the relationship of general and special education, third, the content of specialized training, and fourth, the relationship of research to education. In terms of these basic issues, the historical continuum of the university school of education suggests

the following generalizations concerning the immediate future:

1. The structural separation of the functions of providing general education and of providing specialized education seems unlikely at the present time.

2. Schools of education must continue to share the professional training function with other university departments.

3. Schools of education must resolve the apparent conflict between the educational and the research functions in their programs for the advanced training of educational specialists.

4. Schools of education must re-examine their purposes. The effective structuring of the functions which now engage in competition requires a clear conception of basic purposes. 408 pages. $5.20

A NOVEL AS PRO-INQUIRY: A CRITIQUE OF SOME ADULT VALUE-CONFLICTS CONDITIONED BY EDUCATION

(L. C. Card No. Mic 58-1183)

John Wallace Pritchard, Ed.D.
Wayne State University, 1957

Supervisor: Dr. Robert Rothman

Value theory may well be sterile (though not useless) when it is held aloof from particular valuating people. Consequently, this dissertation operates on value theory through the medium of a novel, abridged, entitled: Pan's Last April: A Pro-Inquiry into What Is Human. This novel constitutes a philosophical pro-inquiry into the interplay of certain adult culture-values which are conditioned by education, and which make problems for education by creating cultural disturbance.

The dissertation is divided into two sections: Section I is a procedural commentary; the longer Section II is the novel.

Section I

In the novel, we seek to create a contexture; we do so with largely provocative intent; the contexture being personal-interpersonal, we develop certain fugues of character; the problem-content is the one-world problem, the scene being France as one geo-cultural node of Western intercultural questions. The words underscored above express key aspects of the multiplex purpose. To clarify this purpose, procedural discussion is required relative to the terms pro-inquiry and contexture; for this is to be, not a didactic novel, but a contextural pro-inquiry in which the critique, by generating pattern, becomes creative.

With respect to philosophical inquiry in education, the following warning by John Dewey is stressed: "If we assume, prematurely, that the problem involved is definite and clear, subsequent inquiry proceeds on the wrong track."[1] No problem in this novel is more than a pro-problem.

Pro-inquiry is the first phase of a progressive inquiry-situation. It is (briefly) the process of noticing and roughing-out the problematic uniqueness of an indeterminate situation prior to formulating problems for more highly structured inquiry. The use of an efflorescence of trial hypotheses is essential to the procedure. Its termination is NOT a set of clear "conclusions," but is instead the exhibiting of a not-too-rigid but reasonably distinctive pattern which suggests how to begin projecting fairly definite hypotheses and tentative procedural rules.

This "terminal" pattern is essentially what is meant by the use of the word contexture. However, this special word connotes, not merely an intellective nor merely an affective pattern, but an intellective-affective pattern-quale - a MIND - conferring meaning and value on ideas. Hence, a contexture operates, not as a starting-"point," but as a starting-"climate," for subsequent inquiry.

Section II

In the novel, the protagonist Pan chooses to scrutinize certain pro-problems as components of the one-world problem-complex in its psycho-social aspect: these are abbreviated in one place as "internationality-success-sex-bleach-romance-democracy-individualism-eternity-spirit." The culture-complex in primary focus is the whole Graeco-Roman-Gothic West; and Pan's guide-question is: "What can be done with respect to the threatened rigor mortis of Europe?" But his prior, controlling question is: "What does it mean, distinctively, to be human?"

It would not be procedurally correct to attempt an abstract of a novel which intends to do its allotted work as a cumulative whole. However, three indications can be made here. First, the novel assumes generally that educators will have decisive effect in world development even though they may not always be called "educators." Second, the novel develops the notion that a Challenger, or catalyst, genus of educator needs to be identified among other classes of educator. Third, for such challengers, Pan ends by proposing "a space-time-roving, mind-roving, creative-exploratory contexture; a rollicking-pensive, irreverent-reverent, romantic-naturalistic, gustatory-rational, intently facile, sympathetic-decisive contexture." Whatever this means "is, I dare to hope, suggested in what I have tried to BE, though it is denied in much that I have blundered into DOING." 281 pages. $3.65

1. Logic: The Theory of Inquiry (New York: Henry Holt and Company 1938), p. 108.

PRESBYTERIAN INTEREST IN ELEMENTARY EDUCATION IN NEW JERSEY, 1816-1866

(Publication No. 23,290)

John Edwards Trowbridge, Ed.D.
Rutgers University, 1957

The purpose of the study was to discover and interpret the attitudes and activities of Presbyterian synods and presbyteries in New Jersey, and their agencies, with respect to elementary education in New Jersey during the period 1816-1866.

The study technique was the historical method. Data were found among the collections of papers of John

Maclean, in the libraries of Princeton and Rutgers Universities; among the synodical and presbyterial records chiefly located in the Presbyterian Historical Society in Philadelphia; in issues of the Newark Sentinel of Freedom in the New Jersey Historical Society in Newark; and in numerous books and other sources as shown in the bibliography.

After the major portion of the data was assembled and evaluated, a narrative synthesis of the pertinent material was written. This narrative started with the backgrounds of Presbyterian church history and the early history of elementary education in New Jersey. Thereafter the dissertation was concerned with two broad, interrelated themes: (1) The interests and activities of Presbyterians in New Jersey in schools sponsored by the church or its agencies. (2) The interests and activities of Presbyterians in the state relative to public elementary education.

The findings have been grouped under three headings: (1) The study's contribution to narrative history. (2) The interplay between sectarian education and public education in New Jersey, 1816-1866. (3) The difficulties of sectarian education.

As to the first, the study pictures life in early nineteenth-century New Jersey, showing how the educational anarchy prevailing at the beginning of the century was replaced by mid-century with a state-wide system of elementary education. It shows the poverty and isolation of peoples in the northern mountain region and in the southern Pines of the state and their concomitant educational needs. It depicts the suspicions of these groups toward attempts to aid them.

The dissertation definitely establishes that Robert Baird was the chief organizer of the public sentiment which resulted in New Jersey's first state-wide school law, that of 1829; and that he did this as an employee of the Presbyterian agency, the Princeton Corresponding Executive Committee of the New Jersey Missionary Soceity, while directing a system of mission schools for the Committee.

It strongly suggests that within this same Princeton Committee a smaller group including Baird, Theodore Frelinghuysen, and John Maclean acted as an informal steering committee for the promotion of the school law of 1829. It points out the close correspondence of New Jersey's present public school system to John Maclean's plan for such a system, published in 1829.

As to the interplay between sectarian education and public education in New Jersey, 1816-1866, the study shows that inferences drawn from the generalizations of educational historians that sectarian interests invariably opposed public education are misleading. On the contrary, the activities of Presbyterians in the state until after 1830 were directed toward the establishment and support of a sound system of public education. Such sectarian schools as were established prior to 1830 were intended to fill an educational void.

Advocacy of parochial schools, which appeared in mid-century, is shown to have been a deviation from the preceding and succeeding policy of American Presbyterians. Parochial schools appeared in only one of the two branches of Presbyterianism in New Jersey, and failed to gain effective support within this branch.

Finally, the dissertation shows that sectarian elementary education generally is difficult to finance, complicated to administer, and divisive in social relations. Despite these undesirable characteristics it still has its adherents, but the Presbyterian Church has not been among them for many years. 503 pages. $6.40. Mic 58-4812

EDUCATION, PHYSICAL

AN EXPERIMENTAL STUDY OF GOLF PUTTING USING BEGINNING GOLFERS

(L. C. Card No. Mic 58-884)

Robert Thompson Bowen, Jr., Ph.D.
University of Michigan, 1957

The purpose of this study is to investigate the effectiveness of an experimental method of golf putting and to ascertain if beginning golfers tend to commit errors in characteristic patterns. The specific problems involved (1) a comparison of the results of two groups of beginning golfers putting on various putting surfaces with one group looking at the ball and the other looking at the hole while putting, (2) a study of both groups to determine characteristic errors of beginning golfers, and (3) an analysis of the effect of terrain and distance on the putting success of beginners.

A survey of the writings of professional golfers showed certain points of major emphasis regarding putting fundamentals but a lack of general agreement as to their importance. The professional literature showed only a minimum of experimentation in golf techniques.

The study was conducted using subjects selected from the University of Georgia Physical Education program for men. Two groups of fifty each were selected and equated on the basis of results of the Iowa Brace Test of Motor Educability. Each group was taught a different putting technique on a level surface. After each subject attained a given proficiency level he was tested for putting skill at three distances over a level surface, an uphill-sidehill surface, a downhill-sidehill surface, and an undulating surface. Errors of distance and direction were recorded.

An analysis of errors was made on three hundred putts per subject or a total of thirty thousand putts, to compare results obtained by the two methods. Comparisons of errors were made in the following categories: (1) mean distance error, (2) ability to hole out, and (3) extreme measures of degree of skill. Errors in both groups were analyzed to determine differences in (1) total number of shots long and short of the hole, (2) total number of shots on the uphill and downhill side of the hole, and (3) mean distance errors on long and short shots. The relationship of the effect of different surfaces on the putting skill was examined.

The results showed no significant difference between the two groups in the ability to get the ball into the hole or in the ability to place it close to the hole. The conclusions drawn from study of the two methods are that (1) for shorter putts the beginner errs by overputting, (2) on sloping surfaces at medium length distances the beginner has a tendency to under-estimate the effect of the hill, (3) as the length of the putt increases the characteristic of under-estimating the influence of the hill becomes less pronounced. Comparing distance errors of putts going long or stopping short shows that (1) short putts generally stop closer to the hole, (2) as putts lengthen the difference diminishes, and (3) increasing problems of terrain and direction reduce the difference. Finally, the effect of different surfaces indicated that (1) increasing problems of terrain increases mean distance errors, (2) it is easier to get the ball closer to the hole on downhill putts than on uphill putts, and (3) an undulating surface presents the

greatest problem to the beginning golfer in both distance and direction. 87 pages. $2.00

THE EFFECTS OF A SEASON OF BASKETBALL PRACTICE ON MALE COLLEGE FRESHMEN AS INDICATED BY SELECTED TESTS OF FATIGUE

(L. C. Card No. Mic 58-914)

Barbara Ellen Forker, Ph.D.
University of Michigan, 1957

The purpose of this study was to determine the effects of practice sessions of basketball on a freshmen squad by the use of the following selected tests of fatigue: patellar reflex, reaction time, pulse rate before and after a step, test and grip strength. In addition data were collected on height, weight, and such subjective information as hours of sleep, eating habits, incidences of illness, academic examinations and previous exercise.

The experimental group was composed of twenty-two members of the freshman basketball squad at Iowa State College. The control group consisted of eleven volunteer freshmen physical education majors. Throughout the basketball season, there were twenty-six testing sessions from which data were collected on the experimental group before and immediately after basketball practice. The control group was given a single test battery at approximately the same time of day as the experimental group.

A graphical analysis of the data was presented on the weekly mean values of the selected tests for both groups. A statistical analysis was presented by the calculation of t-tests on the pre- and post-practice mean scores of the experimental group. The t-values obtained revealed that there were significant changes in the patellar reflex and grip strength which indicated the presence of fatigue. Reaction time significantly decreased indicating that the practice was not fatiguing enough to be detected by the reaction time test.

Three periods of time were selected as the basis for further t-tests to reveal the significance of the changes that might occur. They were as follows: (1) first seven test periods which were used as base line figures, (2) first week in January which would reflect a month's vacation and (3) last week of testing which were used as end of the season figures. The results of the t-tests calculated on the means between the first seven test periods and the first week in January and between the first week in January and the last week of testing on all the selected tests indicated that both groups did not progress in the direction of fatigue except in one instance. The threshold of the patellar reflex increased for both groups between January and the end of the season. The results of t-tests calculated on the first seven test periods and the last week of testing for the control group did not reveal a fatigue state at the end of the season except in the case of the patellar reflex.

The hypothesis was postulated that the experimental subjects (basketball players) will make a complete recovery from fatigue between practice sessions and this state will be evident in the pre-practice test results from the beginning to the end of the season. This hypothesis is accepted because:

1. The patellar reflex test results did not change significantly.
2. The reaction time test results decreased significantly indicating a faster reaction time.
3. The pulse rate before and after the step test lowered significantly indicating a better condition at the end of the season.
4. The grip strength test results improved significantly resulting in a stronger grip at the end of the season.

112 pages. $2.00

THE EFFECT OF RAPID WEIGHT LOSS ON SELECTED PHYSIOLOGIC RESPONSES OF WRESTLERS

(L. C. Card No. Mic 58-968)

Harold Junior Nichols, Ph.D.
University of Michigan, 1957

The purpose of this study is to investigate (1) the effects of rapid weight reduction on selected physiologic responses of wrestlers and provide scientific data as a foundation for answering the question of impairment of the performance of wrestlers as a result of rapid weight loss.

Two groups of wrestlers were used in the study each with twenty-one subjects. One group served as a control and did not reduce their body weight. The other, the experimental group, engaged in periodic rapid losses of weight for the purpose of weighing-in to compete in a wrestling meet or tournament.

Data were obtained from five physical efficiency tests given to the subjects in both groups over a period of ten weeks and involved twenty-four trials in each test. The tests selected were those which would measure the physical efficiency within the more important attributes of wrestlers, namely, (1) balance, (2) reaction time, (3) strength, (4) power and (5) endurance.

The tests were administered each day of the first week to establish a base line and were then administered twice each week for the duration of the testing period.

Weight reduction was limited to the actual conditions currently used by wrestlers to rapidly reduce the body weight with no attempt being made to govern the technique used. The amount of weight loss was limited to that normally lost by the wrestler to weigh-in at a specified weight for competition. The amouts lost by the wrestlers varied from three to eighteen pounds or up to 11.11 per cent of the body weight, with an over-all average of 10.29 pounds and 6.78 per cent of the body weight.

Statistical analysis of the data was made by computing and comparing the group means and evaluating the differences in the group means by the t-test for each test in the first five trials, last two trials for the control and experimental groups and the experimental group when reducing weight and not reducing weight. Statistical data is presented in tabular and graphic form.

The results of the tests supported the hypothesis that the physical efficiency of the wrestlers would not be

significantly affected by weight reduction up to 10 per cent of the body weight.

The conclusion is reached that weight loss within the limits of the study, does not materially affect the strength of the wrestler, slow the reaction time of the wrestler, affect the ability of the wrestler to maintain balance while in motion, adversely affect the endurance of the wrestler, nor hinder the ability of the wrestler to develop power. Further, that a wrestler may safely rapidly reduce his weight up to 10 per cent of his body weight without adversely affecting the physiologic responses. Further study is recommended to provide additional data and information on the question of rapid weight loss in wrestling.

109 pages. $2.00

THE CONTRIBUTION OF THE FACTORS OF EXPERIENCE AND INDIVIDUAL ATTENTION TO THE IMPROVEMENT OF MOTOR SKILLS AMONG ELEMENTARY SCHOOL CHILDREN OF TESTED LOW MOTOR ABILITY

(L. C. Card No. Mic 58-1017)

Alethea Helen Whitney, Ph.D.
University of Michigan, 1957

The purpose of this study is to discover whether the provision of opportunities for motor experiences in addition to regular physical education classes, together with the use of certain motivating devices, will increase the level of motor performance of selected elementary school children of tested low motor ability beyond the level of performance of children of comparable low motor ability who do not receive additional training and such individualized techniques of instruction. The relationship of growth data to improvement in motor performance is also examined.

Preliminary testing of 156 children in grades one through six is reported. A previously validated series of motor ability test items was administered, consisting of the Iowa Brace Test, Vertical Jump, 50-Foot Hop, Run-and-Under, Run-and-Over, Broad Jump, Dash, and Throw tests. Concurrently, the same children were measured for height, weight, and grip strength.

The lowest-scoring one-third of the children in each grade level became the low motor ability group which was divided into practice and control groups. Tests for homogeneity of grouping were applied, showing the two groups to be statistically not unequal in initial ability.

Both groups received regularly scheduled physical education instruction twice a week throughout the school year. The practice group received additional practice and instruction in motor activities, in 21-24 thirty-minute periods during seventeen weeks. This supplementary program included individualized training in activities selected to offer practice in basic skills involved in performance of the motor ability test battery, but did not include practice in specific test items themselves.

Eight months after the initial testing, the 156 children were re-tested by the same battery, and re-measured for height, weight, and grip strength.

It is indicated that results of testing and training procedures applied to first-grade children were not significant in support of the stated hypothesis; therefore data for first-grade subjects are not reported.

Statistical analysis of the improvement differences from initial to final testing for the practice and control groups is presented. It is indicated that the practice group measurably improved in motor performance beyond the control group in the Brace Test. The practice group did not show significant improvement on the other test items. The control group did not show a statistically significant amount of improvement on any of the eight test items.

It is suggested that the Brace Test may well be the best measure of motor ability used in the battery because it measures qualities such as balance and coordination, possibly more readily educable skills than power, speed, and strength at the age-levels tested. The Brace Test is also the only item in the battery which was adapted to age and sex differences.

Growth rate and growth level indices, computed for the cases in the study, are correlated with improvement scores in motor ability, but show no statistical relationship to motor performance on the entire battery or on the Brace Test alone.

The conclusion is reached that the practice group showed positive gains beyond those of the control group in motor performance as a result of the individualized training program, which gains were statistically measurable through the results of the Brace Test, and that the practice group made significant improvement beyond that which would have been expected if determined simply by chance in five test items, as compared with similar improvement in only two items by the control group. Further research is recommended.

143 pages. $2.00

THE INFLUENCE OF THE YMCA ON THE DEVELOPMENT OF PHYSICAL EDUCATION IN CHINA

(L. C. Card No. Mic 58-1019)

Chih-Kang Wu, Ph.D.
University of Michigan, 1957

This is a study of the historical development and the status of modern physical education in China. Historically, modern physical education began to be introduced into China by foreigners following 1842 when China opened five port cities for international trade and gave Hongkong to Great Britain after the Opium War; however, the rapid development of modern physical education did not occur until after 1895, when the YMCA movement started in China. To facilitate the presentation of the data, the material of this study is organized under topics rather than on a straight chronological basis.

Chapter I is an introduction to the problem of this study. It gives a brief statement of the study and presents the procedure for the approach to the problem.

Chapters II and VI present the over-all picture of China in the order of political history, geography, society, religions, and education. These influences on the development of physical education are analyzed and discussed in these chapters.

Chapter VII concentrates upon the historical development of Chinese indigenous physical education and its concurring trends after it was influenced by the introduction of modern physical education into China.

Chapter VIII is a presentation of the general development of the YMCA in China after 1895; however, the

YMCA's physical work, the main part of this study, is presented in a later separate discussion.

Chapters IX to XII present the physical work of the YMCA in chronological order: the "Period of Introduction," from 1895 to 1908; the "Period of Expansion," from 1908 to 1915, the "Period of Consolidation," from 1915 to 1927; and the "Period of Transition," from 1927 to 1949. The general characteristics of each period are also presented in each chapter.

Chapter XIII gives the general conclusions of this study. It also points out some of the future trends of physical education in China, and follows with several recommendations for further study. Major conclusions reached were as follows:

1. During this span of approximately sixty years, from 1895 on, the YMCA became one of the main forces of the entire reform movement in China. The YMCA leaders promoted pioneer developments in physical education, and the results played an important role in the progress of the modernization of China.

2. During this period of about a sixty-year span, from 1895 on, the YMCA leaders faced limitations in the way of leadership, finance, and equipment and facilities, but they managed to overcome a great many of these obstacles through their vision and creative planning, through their genuine enthusiasm for their work, and through the cooperation of the Chinese people themselves.

3. The YMCA initiated all athletic organizations and contests, locally, sectionally, and nationally, and was the motivating force in stimulating the Chinese delegations to participate in the emerging international contests.

4. The YMCA first founded physical education leadership training classes as a part of its over-all training center plan, and thereby developed a sound system of leadership training which has carried down to the present time.

5. The YMCA laid down the broad fundamental principles of physical education in China by which "physical education is a part of education." As a consequence, physical education has never sought for itself aims outside of the total concept of education. Down to the present, therefore, there has been no indication of professionalization in athletic sports nor of any other form of commercialization of physical education in China. 218 pages. $2.85

EDUCATION, PSYCHOLOGY

THE RELATIONSHIP BETWEEN SOCIABILITY, SATISFACTION, AND ACADEMIC ACHIEVEMENT IN VARIOUS TYPES OF LEARNING SITUATIONS

(L. C. Card No. Mic 58-1374)

Leslie Robert Beach, Ph.D.
University of Michigan, 1957

The purpose of this study is to investigate the relationship between a personality trait, sociability, and achievement and course satisfaction in different types of college learning situations. The experiment was conducted in an advanced educational psychology course at the University of Michigan. The subjects were ninety-eight upperclass undergraduate and graduate students enrolled in the Psychology of Child Development course during the fall term of the 1956-57 school year.

Four experimental learning situations were established: (1) a classroom lecture situation, (2) a classroom interactive discussion situation, (3) small study groups (four or five members) independent of formal instruction, and (4) an independent study situation.

The F2-S scale (Flanagan's second factor) of the Bernreuter Personality Inventory and the S scale (social introversion-extraversion) of Guilford's Inventory of Factors STDCR are used as measures of sociability. Achievement is measured in terms of gain on a post-experimental achievement test over the score earned on identical items given as a pre-experimental test.

The general hypotheses which are tested are as follows:

> The more sociable student will achieve more in and be better satisfied with a course permitting large amounts of interaction (such as an interactive discussion section or small group study) than will the less sociable student.
>
> The less sociable student will achieve more in and be better satisfied with a course characterized by minimal interaction (such as a lecture section or totally independent study) than will the more sociable student.

These general hypotheses are adapted to the experimental groups in the form of specific hypotheses for each learning situation.

The findings indicate that the hypotheses receive only partial and scattered support. The most support appears in the lecture group where the positive results favor the less sociable students and in the independent small groups where the positive results favor the more sociable students. In the interactive discussion group, the findings are consistently--and on all measures--in a direction opposite to that predicted. In general, the findings of the study indicate that there are important relationships between the personality of the learner and the type of learning situation. These relationships need further investigation.

Conclusions drawn from the study are: (1) sociability is a complex trait and the two measures used do not measure the same facet of the trait; (2) the relationship of sociability to the outcomes in the course in child development, C175, are dependent upon the definition of sociability and the type of learning situation; (3) the more sociable student does well under conditions of close interaction with a few people and freedom from instructor contact and supervision; (4) the less sociable student does well under conditions of minimal interaction, the presence of an instructor in the learning situation, and a structured presentation of course materials and information; (5) academic achievement and course satisfaction are not highly correlated. 113 pages. $2.00

THE RELATIONSHIPS BETWEEN RESPONSES TO PUPIL AGRESSION AND SELECTED PERSONALITY CHARACTERISTICS OF STUDENT TEACHERS

(L. C. Card No. Mic 58-881)

Carson Mahan Bennett, Ph.D.
University of Michigan, 1957

This study investigates the relationship between the assessed direction of student teachers' responses to pupil aggression in the immediate classroom situation and certain personality characteristics of the student teachers.

A questionnaire was developed using secondary level student teachers as subjects. This instrument, named the EII Questionnaire, was used to assess the directions of student teachers' responses to pupil aggression. The directions of response are extrapunitive (Aggression is projected onto the environment; the student teacher blames individual pupils or group of pupils.), impunitive (Aggression is avoided; the student teacher neither projects nor introjects blame.) and intropunitive (Aggression is introjected, resulting in self-blame or a blocking of response.). There are twenty-five items on the questionnaire, for each of which there are five responses which are framed in terms of these directions. The other personality characteristics--direction of response to frustration in general (extrapunitive, impunitive or intropunitive) and conscious feelings of security or insecurity--were assessed by two standard instruments, the Rosenzweig Picture-Frustration Study and the Maslow Security-Insecurity Inventory respectively.

Five groups of fifteen each were selected from a group of 110 secondary level student teachers for use in the study. The five groups were composed of the fifteen high scorers and the fifteen low scorers on the Maslow Inventory, and the fifteen most extrapunitive, the fifteen most impunitive and the fifteen most intropunitive student teachers on the basis of their scores on the Rosenzweig test. The EII Questionnaire was administered to these five groups of student teachers. It was also administered to their pupils and critic teachers, to respond to in terms of how they judged the student teachers would respond. Data relevant to other factors were collected. A statistical analysis of the data was made to test the hypotheses formulated for the study. The results of this analysis and the major conclusions drawn from them are presented below.

A significant relationship was found in the data secured from the Maslow Inventory and the Rosenzweig test. The more "secure" student teachers tended to give impunitive responses to frustration, while the more "insecure" student teachers gave extrapunitive responses to frustration.

Student teachers' judgments of the direction of their responses to pupil aggression in the immediate classroom situation, as measured by the EII Questionnaire, did not differ significantly when the student teachers were grouped on the basis of Rosenzweig scores or Maslow scores. It is possible that the classroom situations described in the EII Questionnaire inhibit or modify certain kinds of responses to aggression which are not influenced by the Rosenzweig situations. Such inhibition is probably due to the impact of teacher training.

In general, neither critic teachers' judgments nor pupils' judgments of the directions of the student teachers' responses to pupil aggression differed significantly with regard to student teachers' scores on either the Rosenzweig test or the Maslow Inventory.

When responses to the EII Questionnaire by student teachers, pupils and critic teachers were compared, pupils judged student teachers to be more extrapunitive in their responses to pupil aggression than did either student teachers or critic teachers. At the same time, student teachers judged themselves to be more impunitive than either the pupils or critic teachers did, and critic teachers judged student teachers to be more intropunitive than either the student teachers or pupils did. This would seem to indicate that the EII Questionnaire might be used to assess differences in the ways in which student teachers, pupils and critic teachers interpret classroom situations involving pupil aggression. 281 pages. $3.65

THE NATURE OF CHAUVINISM AMONG JEWISH ADOLESCENTS

(L. C. Card No. Mic 58-909)

Harry Essrig, Ph.D.
University of Michigan, 1957

The purpose of this study is to ascertain if personality variables rather than religious background and training play the significant role in determining the chauvinistic attitudes of Jewish adolescents toward their minority group membership. Such attitudes are analyzed within the larger framework of adjustment to group status. The sense of belonging is compounded of both positive and negative elements. Ambivalence is more tolerable for some individuals than for others, depending on the intensity of the feelings displayed. On the basis of the psycho-analytical concept of reaction-formation, it is found that exaggerated glorification may be accompanied by the excessive dislike of the group, as a defense mechanism on the part of the ego. For some individuals, on the other hand, chauvinism does not serve as a disguise for derogration of the minority group.

The research population consists of 356 Jewish boys and girls of high school age in Metropolitan Detroit, drawn from the Orthodox, Conservative and Reform denominations. The battery of tests is composed of the following: the Rotter Incomplete Sentences Blank, High School Form; scales measuring Jewish Chauvinism and Jewish Anti-Semitism; the Fascism Scale; the Traditional Family Ideology Scale; items measuring relationships between adolescents and their parents. The Chi-square test is used to validate the hypotheses.

The results are as follows: Jewish Chauvinism and Jewish Anti-Semitism, though manifestly opposite reactions, are significantly related to each other. Reaction-formation chauvinism is part of a more general syndrome characteristic of the authoritarian personality, as measured by the Fascism Scale. Reaction-formation chauvinists tend to display a more authoritarian orientation toward family structure and functioning, as measured by the Traditional Family Ideology Scale. There is no significant relationship between the various categories of chauvinism and the Rotter Incomplete Sentences Blank, High School form. Reaction-formation chauvinism is significantly characteristic of the Orthodox denomination; however, because of the very inadequate representation of this group in the population studied, this result is stated tentatively,

pending further research. The male adolescents produce a higher number of reaction-formation chauvinists than do the girls.

Three general conclusions can be drawn from the study. 1) Ambivalence toward minority group membership, when expressed in moderate form, is a normal phenomenon. 2) There are two types of chauvinism. The reaction-formation variety is found in authoritarian personalities; the genuine kind, in those with more democratic tendencies. We do not know what factors operate to produce this differential. 3) There may be a closer relationship between religious affiliation and authoritarian personality trends for the minority than for the majority group members.

162 pages. $2.15

A COMPARATIVE STUDY OF RELIGIOUS AUTHORITARIAN-PERMISSIVE ATTITUDES TOWARD CHILD TRAINING AND DEVELOPMENT

(L. C. Card No. Mic 58-980)

Roy Dixon Robinson, Ph.D.
University of Michigan, 1957

The purpose of this study is to test two hypotheses concerning the attitudes of Catholic, Jewish, and Protestant clergymen regarding the training of the child.

The first hypothesis is that Catholic, Protestant, and Jewish clergymen differ in degree of educational authoritarianism-permissivism toward child-training methods and goals, the Jewish being most permissive, the Catholic least permissive, with the Protestant intermediate to these two groups. The second hypothesis is that authoritarian attitudes toward child training and development are positively correlated with attitudes of religious conservatism, and permissive attitudes toward child training and development are positively correlated with attitudes of religious liberalism.

To test these hypotheses an opinion rating-scale was constructed containing statements dealing with most of the major issues in contemporary education. By means of the Thurstone "jury" method these statements were validated as either authoritarian or permissive statements about educational issues. A pilot study was made with Catholic, Protestant, and Jewish clergymen to discover if the statements differentiated among these groups. The statements appeared to reveal differences among the scores of the pilot-study subjects and a large sample was drawn for the experiment proper.

This sample was selected through the executive secretaries, bishops, etc., of eighteen denominations and subdenominations in metropolitan Detroit who appointed clergymen within their various denominations whom they felt were best qualified to represent the attitudes of their denominations toward educational aims and methods.

Fifty-eight such clergymen were interviewed individually and expressed their attitudes toward eighty-four statements measuring degrees of authoritarian and permissive attitudes toward the education of the child, and ten statements measuring religious conservatism-liberalism. The subjects indicated their attitudes by placing the statements, which were typed individually on cards, in a box with six compartments which were labeled "complete agreement or almost complete agreement," "essential agreement," "mild agreement," "mild disagreement," "essential disagreement," and "complete or almost complete disagreement."

The following results were obtained. The rank order of the eighteen denominations and subdenominations from most authoritarian to most permissive was: Missouri Synod Lutheran, Roman Catholic, American Lutheran, United Lutheran, United Presbyterian, Augustana Lutheran, Greek Orthodox, Episcopal, Suomi Lutheran, American Baptist, National Baptist, Presbyterian (USA), Methodist, Jewish Orthodox, Congregational, Jewish Conservative, Jewish Reform, and Unitarian. The rank order of the eighteen denominations and subdenominations from most religiously conservative to most religiously liberal was: Roman Catholic, Missouri Synod Lutheran, Greek Orthodox, Jewish Orthodox, Episcopal, American Lutheran, United Lutheran, Augustana Lutheran, National Baptist, Presbyterian (USA), American Baptist, Suomi Lutheran, Jewish Conservative, Jewish Reform, Methodist, United Presbyterian, Congregational, and Unitarian. A positive correlation of .56, significant at the .01 level, was found between the authoritarianism-permissivism scores and the religious conservatism-liberalism scores.

An analysis of variance revealed significant differences among Catholics, Protestants, and Jews on both authoritarian-permissive attitudes and conservative-liberal attitudes. However, larger and more representative samples are necessary before broad generalizations can be made.

309 pages. $4.00

A STUDY OF EMPATHIC RELATIONSHIPS BETWEEN PUPILS AND STUDENT TEACHERS IN GIRLS' PHYSICAL EDUCATION

(L. C. Card No. Mic 58-1457)

Candace Lillian Roell, Ph.D.
University of Michigan, 1957

The purpose of this study is to get at measurement of empathic relationships between pupils and student teachers in girls' physical education through the use of certain assessment questionnaires.

The subjects were 710 high school students, 26 student teachers, and 6 supervising teachers. Two assessment inventories and six predictive tests were taken by the student teachers. The two questionnaires were given to the prospective teachers to determine self-perception of their ability to establish positive interpersonal relationships with the class and with individuals in the group. The high school students answered an assessment questionnaire concerning their judgment of the student teachers, adults, teachers, and their peers. The inventory administered to the judge or supervising teachers was to discover how the supervising teachers thought the high school students felt about the prospective teacher.

In addition to the questionnaires, certain personality inventories were given to the student teachers in an attempt to discover what could be used to predict their ability to empathize. The tests given were: Family Adjustment Test, of Elias; Security-Insecurity Inventory, by Maslow; F-Scale, of Frenkel-Brunswick; Thematic Apperception

Test for Teachers, by Theron Alexander; Self Concept Test, of Brownfain; and Teaching Concept Test, of Rasmussen.

The data obtained from the ten inventories were analyzed and treated statistically. Large-sample statistic Pearson r, coefficient of determination, Fisher's analysis of variance, and Fisher's t test were employed.

The specific hypotheses from this study are concerned with (1) ratings secured from the assessment inventories and the relationships to each other, (2) testing the predictive instruments and their resemblance, and (3) determining the interrelationship of the assessment and predictive measures.

The questionnaires revealing perceptions of the student teachers themselves, high school students, and supervising teachers give a consistent conception. If the student teacher is rated high by one group she is rated high by all groups. The student teachers tested are largely within the normal range on the predictive instruments used, with the exception that there is a tendency to be autocratic and to have a borderline unrealistic view of their family relationships. The only correlation among the predictive tests that indicates a significant relationship is between Self Concept A and Teacher Concept B tests (+ .58). Relationships between the predictive tests and assessment measures show only one significant correlation. There is a -.47 relationship between the Security-Insecurity Inventory and the questionnaire taken by the supervising teacher.

Within the limitation of this investigation the following conclusions appear to be valid:

The general hypothesis that there is a significant relationship among the various assessment instruments has been supported, as the correlations are all positive. The results indicate that if empathic ability is being aware of how one is rated by other people, then these student teachers possess that quality.

The specific hypotheses concerning the predictive instruments is that the results between Self Concept A and Teacher Concept B cause us to reject the null hypothesis. The correlation between the two measures is significant at the 1 percent level of confidence. The relationships between all of the other predictive measures are too low for statistical significance. The correlations between assessment and predictive instruments reveal only one significant relationship, which was between the Security-Insecurity Inventory taken by the student teacher and the rating given her by the supervising teacher (-.47).

Although there are yet many unanswered questions, the positive relationship between the assessment questionnaires, on the basis of these findings, indicates a promising step for a better understanding of what is involved in empathic ability and for the application of rating scales in its measurement. 175 pages. $2.30

SOME ASPECTS OF THE RELATIONSHIP BETWEEN PERCEPTION AND MOTILITY IN CHILDREN: AN INVESTIGATION OF CERTAIN VISUAL AND TACTUAL PERCEPTUAL TASKS IN CHILDREN AND THEIR RELATIONSHIP TO VARYING DEGREES OF MOTILITY

(L. C. Card No. Mic 58-666)

Esther P. Rothman, Ph.D.
New York University, 1957

This study was designed to investigate the relationship between motility patterns and perception in children. It was based on the premise that varying degrees of motility bear a definite relationship to performance on visual and tactual perceptual tasks.

The experimental population consisted of four groups of children representing different degrees of motility patterns. The schizophrenic whirlers represented hypermotile patterns; the poliomyelitis group represented hypomotile patterns. The controls and schizophrenic non-whirlers represented non-disturbed or normal motility patterns.

The four groups were matched for age and intelligence. Ages ranged from nine to fourteen; intelligence quotients ranged from 90 to 129. All the children were white males.

Two sense modalities, visual and tactual, were considered. Within each modality, two tests were administered to each subject, a test of figure and ground discrimination and a test of perception of form. Thus, four tests were administered to each subject.

The findings of this study indicated that in the visual area, a significant difference existed between groups aligned on the basis of motility. When the same population was aligned on the basis of presence or absence of schizophrenia, no significant difference was elicited. Specifically, in the visual perception of form, the disturbed motility group (poliomyelitis and schizophrenic whirlers) were superior to the non-disturbed motility group. On the other hand, on the visual perception of figure and ground, the disturbed motility group (poliomyelitis and schizophrenic whirlers) were inferior to the non-disturbed motility group.

In the tactual perceptual tests, the findings were less clearly defined. Neither schizophrenic nor motility proved to be a significant variable for either test. However, the schizophrenic non-whirlers were significantly inferior to all other groups in the tactual perception of form. On the tactual perception of figure and ground, the schizophrenic whirlers and controls were superior to the schizophrenic non-whirlers and poliomyelitis groups.

From the general lack of correlation between tests, it would appear that visual perception and tactual perception, as they were measured in this investigation, were not significantly related to each other.

While the findings of this investigation cannot be generalized beyond the limits set for this study, the data suggest a definite relationship between certain modes of perceptual behavior and motility status. An examination of the data suggests that motility patterns are basic predetermining factors to patterns of perception. It also suggests that superiority of perception may result as an overcompensatory mechanism for the biologic defect of a disturbed motility pattern.

Further explorations in motility as it relates to perception would lead to some reevaluation not only of perceptual theory, but also of personality theory. Personality

evaluation and psychiatric diagnosis are most commonly made on the basis of perceptual performance. If, however, motility status underlies basic perceptual modes, then personality evaluation should be based upon motility patterning rather than upon perceptual performance. An experimental approach measuring varying categories of motility disturbances would aid in clarifying personality evaluation and psychiatric diagnosis. 127 pages. $2.00

AN INVESTIGATION OF DELAYED COMPREHENSION AND ITS RELATIONSHIP TO OTHER ASPECTS OF READING AND TO ACADEMIC SUCCESS

(Publication No. 25,420)

Arthur Wesley Sherman, Jr., Ph.D.
The Ohio State University, 1952

PURPOSE

Reading is an important tool for the average college student, and research has shown that competence in reading is directly related to scholastic success as measured by grades. While certain areas of reading skills have been adequately measured by available standardized tests, there are certain neglected areas. One of these neglected areas is the delayed measurement of comprehension of verbal materials. This is a typical requirement of the college student, as the large number of teacher-made achievement tests administered in the average college during any given period indicates. Furthermore, the familiar practice of "cramming" before an examination reveals that many students are uncertain of their skill in remembering the material that is needed to achieve a satisfactory grade on an examination. In view of the apparent importance of delayed comprehension and the lack of scientific knowledge about it, this study was designed to provide answers to the following questions:

(a) What are the general characteristics of delayed comprehension and how may delayed comprehension be measured most effectively?

(b) Is delayed comprehension an independent aspect of reading, i.e. does it differ appreciably from other reading skills, so that its measurement is of practical value in college testing programs?

(c) What is the relationship between delayed comprehension and academic success?

(d) Does the administration of an immediate test of comprehension affect performance on a delayed test of comprehension?

HISTORY OF PROBLEM

A study of what reading test purport to measure and the factors that have been identified by factor analysis studies reveals that word meaning, paragraph comprehension, and rate of reading are commonly measured by standardized reading tests. While these isolated factors have considerable acceptance among reading test constructors, it is to be expected that a factor analysis will yield only what is put into it. The current proposal that the measurement of delayed comprehension is a neglected variable is merely one attempt to broaden the horizons on the nature of reading skills. In order to provide an orientation and background for understanding delayed comprehension and its significance in the reading process, this variable should be studied in relation to the commonly measured aspects of reading mentioned above.

Some of the major criticisms of currently available reading tests indicate that in the construction of a reading test designed to measure delayed comprehension and other variables, attention should be given to such deficiencies as (a) the artificial and superficial requirements of many tests, (b) the unreliable measurement of reading rate, and (c) the lack of non-prose materials. The experiment was designed to overcome some of these shortcomings.

As a basis for examining delayed comprehension, certain evidence from the literature on the psychology of forgetting is pertinent to the problem. Other studies in this area have revealed that immediate and delayed comprehension are by no means identical, and that the measurement of delayed comprehension can be made as early as twenty-four hours after reading with significant results. In addition, since different methods of measuring retention and different types of materials and/or questions yield different results, careful consideration has to be given to these factors in the construction of a reading test. Finally, the results obtained from studies in which the effect of immediate testing on delayed testing of retention was measured indicate that it would be advisable to construct separate set of items for immediate and delayed tests of comprehension.

PROCEDURE

In order to study the general nature of delayed comprehension and to determine its relationship to other measures of reading and to scholastic success, it was necessary to construct a reading test that would employ procedures and provide delayed measures of comprehension accuracy as well as those measures ordinarily found in standardized reading tests, namely, reading rate, immediate comprehension, and vocabulary.

In order to overcome the unreliable measurement of reading rate found in many tests and at the same time produce a test of reasonable time limits, it was determined that twenty minutes would be allocated for the reading of the passage that would be used to obtain measures of reading rate and comprehension accuracy scores for both the immediate and delayed testing sessions. The primary criteria for the passage were that the material should approximate the level of difficulty of material found in the average textbook used in typical freshman courses and that the selection should require the use of higher levels of reading skill. After an investigation of approximately fifty different publications of the inexpensive pocketbook type, one book was selected as best for this purpose. Three subject-matter specialists confirmed that the selection was authentic and suitable for the purpose.

Multiple-choice items for measuring the accuracy of comprehension were constructed in such a way that the material in the long reading passage would be sampled adequately and uniformly. The 47 items judged most adequate by the test experts and subject-matter specialists were grouped into two sets of items of approximately equal difficulty level that uniformly sampled the entire reading passage.

A study of textbooks revealed that certain non-prose

skills were required. Typical non-prose materials, including tables, line and bar graphs, and cumulative graphs, were selected for this subtest, and multiple-choice items were constructed to measure chart and graph reading skills.

The reading selection and the two sets of comprehension items were administered to three groups of freshmen to evaluate the various parts of the test. On the basis of this trial administration, certain adjustments were made, and a revised test for use in the main experimental study was constructed. The materials in the revised test were assembled so as to provide two different designs, as follows:

Order A

Long prose passage - 20 minutes allowed
Set I comprehension items - untimed - administered immediately
DELAY OF 24 HOURS
Chart and Graph Reading Test - 10 minutes allowed
Set II comprehension items - untimed

Order B

Long prose passage - 20 minutes allowed
Set II comprehension items - untimed - administered immediately
DELAY OF 24 HOURS
Chart and Graph Reading Test - 10 minutes allowed
Set I comprehension items - untimed

It will be noted that the above design makes no provision for the measurement of vocabulary. In order to keep the length of the reading test within practical time limits, it was determined that the Ohio State Psychological Examination would provide a reasonably adequate measure of vocabulary skill.

The revised test was administered in Freshman English classes at the Ohio State University during a two-day period. In order to obtain a random selection, one-half of the students in each class section were administered the test arranged and designated as Order A, and one-half were administered Order B. The twenty-minute reading period for the long prose passage was carefully timed, and at the end of each five minutes of reading the students were asked to write the number of the last numbered line that was read in the passage on Mars. This recording was done on a specially prepared IBM answer sheet.

At the end of the twenty-minute period, all reading booklets were collected and the questions booklets were then distributed. The examiner instructed the students to note carefully the number which was written down as the last numbered line read when time was called at the end of twenty minutes. Reference was then made to the comprehension items, and the students were told to find the line number in the margin of the question booklet which is equal to or less than this number. They were then instructed to answer all items down to and including this number. The purpose of this was to insure that testing of comprehension would be based only on material actually read.

The following day the experimenter appeared at each class in which the test had been administered. At that time the Chart and Graph Reading Test was administered and followed by the delayed measurement of comprehension (Set I items for those being tested with Order B, and Set II items for those being tested with Order A).

A total of 401 students completed Order A of the test, and 384 completed Order B. Because of the analyses to be made of the data, it was necessary to eliminate the cases where testing was incomplete or where the cumulative grade record or Ohio State Psychological Examination score could not be located. Furthermore, it was desired that the population be college students of freshman standing. Therefore, any individuals of higher academic standing who were tested were eliminated from this study. The number of usable cases was ultimately reduced to 345 for Order A and 310 for Order B, making a total of 655 cases. Of this number, 378 were male and 277 were female. An analysis of the scores on the Ohio State Psychological Examination indicates that the two groups, i.e. those tested with Order A and those with Order B, are reasonably comparable.

After careful scanning of the IBM answer sheets and a check to insure that an individual did not answer comprehension items that were over material beyond the point where he had finished reading at the end of twenty minutes, the answer sheets were scored by the electric test scoring machine. Two scores, the number of correct items and the number of items attempted, were obtained for each of the following subtests: immediate test of comprehension, delayed test of comprehension, and chart and graph reading. The cumulative number of lines read at the end of 5, 10, 15, and 20 minutes was obtained directly from the students' notations on the answer sheet and this provided measures of reading rate. By employing the formula

$\frac{\text{Number correct}}{\text{Number attempted}}$, a comprehension accuracy score was obtained for each individual on each of the three subtests.

Scores on the Ohio State Psychological Examination were obtained from official rosters prepared by the Committee on University Testing and the cumulative point hour ratio for the freshman year was obtained from the university files.

RESULTS

The reading rate reliability was computed by correlating the number of lines read in the first ten-minute period with the number of lines read in the second ten-minute period. The coefficients, after the Spearman-Brown Prophecy Formula was applied, are .865 ± .014 for the group tested with Order A and .837 ± .017 for the group tested with Order B.

The split-half (odd-even) reliability for the comprehension subtests with the Spearman-Brown Prophecy Formula applied are as follows for the Order A population: Set I items (immediate comprehension) .704 ± .027; Set II items (delayed comprehension) .686 ± 0.29; and Chart and Graph Reading .674 ± .029. For the Order B population they are: Set I items (delayed comprehension) .505 ± .042; Set II items (immediate comprehension) .610 ± .036; and Chart and Graph Reading .683 ± .03. The tests are considered to be sufficiently reliable for the analyses made in this study. They are not, however, considered adequate for the individual measurement of reading skills.

Prior to the analysis of the data obtained from administering the reading test to 655 freshmen, an intercorrelation matrix was prepared which shows the interrelationships between the following variables:

The items following each abstract are: the number of manuscript pages in the dissertation, its cost on microfilm, and the Library of Congress card number. Enlargements 5-1/2 x 8-1/2 inches, 4 cents per page. No postage is charged if check or money order accompanies order.

1 - Point Hour Ratio
2 - Immediate Comprehension
3 - Delayed Comprehension
4 - Rate
5 - Chart and Graph Reading
6 - Difference score
7 - Ohio State Psychological Examination

The difference score was designed to express the interaction between immediate comprehension and delayed comprehension accuracy scores. Using the data from the intercorrelation matrix, four hypotheses were tested and these provided answers to the questions stated previously.

First, by means of multiple correlations computed by the Doolittle method, the effect of adding delayed comprehension or the difference score to other tests was studied. It was found that the difference score as defined and employed in this study was not shown to be a more adequate predictor of cumulative point hour ratio than the delayed comprehension accuracy score. For this reason, and because of greater ease in computing it, the delayed comprehension score was used in later computations.

Second, by means of the multiple correlation technique, comparison was made between R1.32457 and R1.2457. The obtained difference between the two coefficients (.528 and .527 for Order A; and .505 and .501 for Order B) was not significant at the .05 level of confidence. It was concluded, therefore, that the addition of delayed comprehension does not increase the predictability of academic success (cumulative point hour ratio) over that obtained from a combination of reading rate, immediate comprehension, chart and graph reading, and the Ohio State Psychological Examination scores.

Third, to determine if delayed comprehension can be considered an independent aspect of reading, mean scores on the immediate and delayed tests of comprehension were compared and the correlation coefficients between delayed comprehension and other measured variables were examined. It was found that the difference between the mean scores on immediate comprehension and delayed comprehension after twenty-four hours was significant at the .01 level. For the population with the higher reliability coefficients (Order A), the following coefficients of correlation, after correction for attenuation, were found: delayed comprehension and Ohio State Psychological Examination r .47; delayed comprehension and chart and graph reading r .43; and delayed comprehension and immediate comprehension r .63. All of these coefficients were found to be significant at the .01 level; the relationship between delayed comprehension and rate of reading was found to be negligible.

Fourth, as a minor issue, the effect of immediate testing on the delayed testing of retention was studied. The data for testing this hypothesis were obtained from the trial administration of the reading test. By comparing the data obtained from groups equated on Ohio State Psychological Examination score, it was found that the difference between mean scores for the group with previous testing and the group that had no immediate testing was not significant at an acceptable level of confidence. This finding varies from those studies where the same identical items were used in immediate and delayed tests of comprehension.

CONCLUSIONS

The evidence cited supports the conclusion that delayed comprehension is a relatively independent aspect of reading that can be measured as early as twenty-four hours after reading with significant results.

It was found that the addition of the delayed comprehension accuracy score to a measure of college aptitude and to other variables ordinarily included in a reading test does not increase the predictability of academic success. However, it is believed that the concept of delayed comprehension should not be rejected as being of no practical value solely on the basis of this fact. It is quite possible that the concept would be of value in the diagnostic approach to reading skills and could be used effectively in how-to-study training. However, before this concept can be used effectively, further research is necessary.

It is essential that answers to the following questions be obtained:

1. What is the most valid method for computing a delayed comprehension score? While measurement twenty-four hours after reading appears to yield significant results, further research is needed on the possible value of a score that represents the relationship between delayed and immediate comprehension.

2. Is there any relationship between delayed comprehension and study and examination skills? While the cumulative point hour ratio is certainly an indication of an individual's performance on examinations, it may be that the inclusion of grades for all types of courses and the unreliability of grades obscures the relationship between delayed comprehension and performance on examinations.

With further knowledge of the nature of delayed comprehension and its relationship to study methods, it is likely that the acquisition of skill in this particular area could be taught as one of the higher-level study skills. The writer is of the opinion that memory techniques are untaught and untested throughout the school years, so that what skills are present are self-learned. Since even the best student is "none too good" in his study methods, this tends to result in a restricted range of competence on the dimension of delayed comprehension, which may account, in part, for the failure of delayed comprehension to add significantly to the prediction of cumulative point hour ratio.

It is recommended that menory skills, based on research, be designed, taught, and subsequently evaluated to determine if the range on a new higher-level skill is then directly related to academic success. Then, the development of reliable and valid instruments for measuring delayed comprehension will make it possible to detect those individuals who are most in need of training in this area.

Finally, the finding that the inclusion of an immediate test of comprehension does not result in improved delayed comprehension accuracy suggests that further study is needed to determine the types of review that are most efficient for the various materials studies in typical academic situations. It seems that there is little generalization that can be made as to the effect of immediate recall on retention. 158 pages. $2.10. Mic 58-4813

Abstract published by special arrangement with The Ohio State University.

INDIVIDUAL DIFFERENCES IN DISPOSITION TO BE ANXIOUS AND THEIR RELATIONSHIP TO ACHIEVEMENT, LEVEL OF ASPIRATION AND NEED FOR ACHIEVEMENT

(L. C. Card No. Mic 58-992)

Avtar Harbaksh Singh, Ph.D.
University of Michigan, 1957

This study investigates the relationship of individual differences in disposition to be anxious to achievement, level of aspiration and need for achievement. The interaction of anxiety as a personality variable with varying degrees of situationally aroused anxiety and its effects on achievement and level of aspiration were also studied.

The measures of disposition to be anxious were: a specific measure of anxiety in previous test situations, obtained through the Test Anxiety Questionnaire, and a general disposition to be anxious obtained from the Manifest Anxiety Scale. Two personality groups were defined: a high anxiety group and a low anxiety group, the former had high and the latter had low anxiety ratings on both the measures.

The subjects were 90 women undergraduate students selected from 310 students from several sections of an Introductory Educational Psychology course, on the basis of their scores on the anxiety measures. There were 45 subjects in the high anxiety group and 45 in the low anxiety group. Three experimental conditions called control, success and failure were created and 15 subjects from each of the anxiety groups were randomly assigned to the three conditions.

The need for achievement was obtained in small groups under neutral conditions by means of a modified form of the Thematic Apperception Test. Achievement and level of aspiration measures were obtained in individual sessions on two tasks: digit substitution and card sorting involving abstract cognitive ability. Instructions were designed to ego-involve the subjects. Each subject had ten trials on digit substitution followed by ten trials on card sorting. The feelings of success and failure were induced by means of a group reference scale and by a comparison of the subject's performance with her level of aspiration. The subjects in the success conditions were given to feel that their achievement was better than the average achievement of the group on every trial on both the tasks, and they were also given falsified reports about their actual achievement distorted in the positive direction after every trial. The subjects in the failure conditions were given to feel that their achievement was much lower than that of the group, and they received falsified reports about their achievement distorted in the negative direction.

An analysis of variance showed a significant interaction between level of anxiety and experimental conditions both for achievement and level of aspiration. The high anxiety group had significantly better achievement and significantly higher level of aspiration in comparison with the low anxiety group in situations where anxiety arousing cues were minimum and when no evaluative or comparative reference was made to achievement. The high and low anxiety groups showed differential reactions to conditions of failure or conditions of a non-supportive nature. These situations were perceived as challenging situations by the low anxiety group and as threatening situations by the high anxiety group. The achievement and level of aspiration of the high anxiety group under failure was significantly lower than that of the low anxiety group. Conditions of success or supportive conditions affected the achievement and level of aspiration of the high and low anxiety subjects in a like manner.

The measures of anxiety and need for achievement were both significantly related to achievement and level of aspiration, but no meaningful relationship was found between them. The interaction of personality factors and situational cues appears to be a better guide to the understanding and interpretation of motivated behavior than either of these factors alone. Implications of the findings for further research in theory of motivation are discussed.

209 pages. $2.75

SOME CORRELATES OF PUPILS' PERCEPTIONS OF TEACHING BEHAVIOR

(L. C. Card No. Mic 58-1305)

Philip Howard Sorensen, Ph.D.
Stanford University, 1958

The Problem

This study concerned the nature and correlates of pupils' perceptions of "good" and "bad" teaching behaviors. It was hypothesized that pupils' perceptions of the nature of "good" and "bad" teaching would vary systematically with pupil sex, teacher sex, achievement level, social class, and social mobility. The study tested this general hypothesis of differential pupil perceptions of teaching behavior. Where differences were identified, the nature of the differential perceptions were analyzed.

Increased understanding of the degree to which pupils' perceptions of teaching behavior may vary with the above variables should enable better prediction of and planning for diverse pupil responses to apparently identical situations. Further, identifying areas of teaching behavior in which these perceptions are most variable should suggest conditions in which the relationships among teaching behavior as the antecedent variable, pupil perception as an intervening process, and pupil performance as the consequent variable can be fruitfully explored.

Methods

To test the hypotheses, 1,779 descriptions of "good" and "bad" teaching behavior were collected from 648 sixth and seventh grade pupils through the use of the critical incident technique. The sample consisted of all 25 classrooms at these grade levels in an elementary school district of a suburban community in California. These classrooms were taught by 11 male and 14 female teachers who appeared as subjects of the reported incidents.

Incidents were ordered into 45 categories representing 4 classes of teaching behavior: (a) Instructional Activities, (b) Classroom Management, (c) Special Activities, and (d) Teacher Qualities and Behaviors. Nonparametric statistical tests of significance were performed for 225 tabulations between each of the 5 variables and "presence of report" over all 45 categories.

Results

A total of 32 associations, significant at or below a probability value of .05, were observed in 26 of the 45 behavior categories. While the number of statistically significant findings was a nonchance proportion of the 225 tests performed, some apparently significant associations may be due to chance factors.

Each variable was involved in the following number of statistically significant findings: pupil sex, 11; social class, 10; achievement level, 7; teacher sex, 2; social mobility, 2.

Conclusions

1. Pupils in this sample tended more often to agree than disagree when describing and evaluating teaching behaviors. This is conceived as a function of at least two conditions: (a) the similarity of past experiences in American public schools which pupils shared, and (b) the variables in whose terms the pupils were contrasted with one another. Greater heterogeneity within the sample and different or additional descriptive variables (e.g., ethnic, religious, attitudinal, personality variables) might have led to different findings.

2. The selected descriptive variables proved generally valuable in differentiating various patterns of pupils' perceptions of teaching behavior. This study did not allow proof of the utility of these variables as opposed to some other set. Among those utilized, however, pupil sex, social class, and achievement level were most useful; teacher sex and social mobility least useful.

3. The critical incident technique proved useful in assembling data for a study of the nature and correlates of perceptions. The orientation in this study was toward the observers (pupils) and the factors which presumable influenced them to perceive and evaluate teachers' behaviors in particular ways. "Teaching effectiveness" was not an issue. This use of the critical incident technique avoided two untestable assumptions which must be made in the conventional employment of the technique: (a) that observers can and do agree regarding the nature and effect of a given critical behavior, and (b) that all observers assign similar meanings to a given behavior.

176 pages. $2.30

THE RELATIONSHIP BETWEEN SELECTED PERSONALITY VARIABLES, SATISFACTION, AND ACADEMIC ACHIEVEMENT IN DEFINED CLASSROOM ATMOSPHERES

(L. C. Card No. Mic 58-1014)

Richard Paul Watson, Ph.D.
University of Michigan, 1957

The purpose of this study was to discover how different group atmospheres in instructional situations affect the academic achievement and general satisfaction of certain personality types. The group atmospheres were determined not by judges' ratings, but by student perceptions. The students were regularly enrolled in the eight sections of introductory educational psychology which differed most widely in respect to atmosphere.

Achievement was measured by both rote memory and transfer-type (i.e., "thought") questions. The personality types were differentiated by two instruments. The standard F scale, purporting to measure the authoritarian-democratic continuum, was supplemented by certain other items and was taken as a measure complementary to the restrictive-permissive dimension of classroom atmosphere. The other instrument was a social approach inventory which has been used to measure a somewhat different dimension that is called permeability-impermeability.

The major hypothesis of the study predicts that students will be more satisfied with and achieve better in those atmospheres that most closely approximate, or complement, their personality types or structures. The major conclusion of the study is that the prediction regarding differences in satisfaction is, with appropriate qualifications, accepted, but the prediction concerning differences in academic achievement is not confirmed. Thus, satisfaction with a course appears to be contingent upon the extent to which its structural characteristics satisfy the needs of the students for a particular type of learning atmosphere. Academic achievement, on the other hand, appears not to be significantly determined by the compatibility of personality and classroom structure.

Investigation of the experimental hypotheses that relate specifically to the study show that: 1) student assessment of achievement is unrelated to personality type and atmosphere structure; 2) subjects feel that an atmosphere complementary to their type of personality is a more effective type of learning procedure for them than one that is antithetical; 3) subjects respond more favorably to examination of their academic achievement in an atmosphere complementary to their type of personality than they do in an atmosphere that conflicts with their needs; and 4) contrary to expectation, rote and transfer achievement appear not to be dependent on personality type--rather, the latter is about the same in both restrictive and permissive atmospheres for contrasting types of personality.

Within the limits of the content and population of the study, two general conclusions can be drawn: 1) satisfaction appears to be enhanced by placing an individual in a classroom structure complementary to his preferences and personality type; 2) academic achievement does not seem to be related to the interrelationship of personality and atmosphere structure. The educational benefit to be derived from placing students in atmospheres similar to their type of personality seems to be contingent upon one's educational goals. 166 pages. $2.20

READING INTERESTS OF CHILDREN IN GRADES THREE THROUGH SIX IN THE PUBLIC SCHOOLS OF NORWALK, CONNECTICUT: AN ANALYSIS OF READING INTERESTS (AS REVEALED BY AN INTEREST INVENTORY) TO INVESTIGATE THE ASSOCIATION BETWEEN THESE INTERESTS AND CERTAIN VARIABLES

(L. C. Card No. Mic 58-670)

Bernice Jurist Wolfson, Ph.D.
New York University, 1957

Chairman: Professor Nila Banton Smith

THE PROBLEM

The purpose of this study was to investigate and analyze the responses of third, fourth, fifth, and sixth grade pupils (in the public schools of Norwalk, Connecticut) to a reading interest inventory to determine if there is an association between these responses and certain variables. The variables considered were: sex, grade, reading achievement, parent's occupation, parents' education, number of books in the home, number of children in the family, and scores on group intelligence tests (in grades three and six).

PROCEDURE

A Reading Interest Inventory was devised consisting of 120 questions in twelve categories, as follows: (1) Adventure, (2) Animals, (3) Fine and Applied Arts, (4) Fantasy, (5) Family Life and Children, (6) Famous People, (7) Machines and Applied Science, (8) Personal Problems, (9) Physical Science, (10) Plants, (11) Social Studies, (12) Sports.

The Inventory was read aloud by the cooperating teachers in two sessions of equal length. The children circled "Yes," "No," or "Don't Know" in response to each item. A Home Questionnaire was taken home for the parents to check and their responses were coded into groups. All the data were placed on IBM punch cards and tabulated by machine. Per cents and chi-squares were also computed by machine.

SUMMARY OF THE FINDINGS

1. The range of interest in individual questions of The Reading Inventory was from 20.6 per cent (of "Yes" responses) to 90.6 per cent.

2. The range of interest as expressed by the mean per cent of "Yes" responses to each interest category was from 35.4 per cent to 77.3 per cent.

3. Many boys were interested in Adventure (77.3%),[1] Sports (75.4%), Physical Science (72.3%), Machines and Applied Science (70.9%), Social Studies (70.0%), Fantasy (68.3%), Animals (67.4%), and Famous People (65.7%).

4. Few boys expressed interest in Fine and Applied Arts (36.1%), and Family Life and Children (44.0%).

5. Many girls were interested in Fantasy (76.4%), Personal Problems (72.9%), Social Studies (69.4%), and Sports (65.7%).

6. Few girls were interested in Machines and Applied Science (35.4%).

7. In general, interest declined as grade level went up.

8. Except for sex and grade, there was little significant association between the variables considered in this study and the responses to The Reading Interest Inventory. (Tested by chi-square.)

CONCLUSIONS

1. Findings concerning the home factors and the responses on the Inventory do not provide sufficient basis for rejecting the hypothesis of no relationship. (Home factors were: parent's occupation, parents' education, number of books in the home, and number of children in the family.)

2. The hypothesis of no relationship between sex and responses to the Inventory may be rejected for all categories except Social Studies.

3. Chi-square was used to test the hypothesis that children at different grade levels show no difference in responses to The Reading Interest Inventory. This hypothesis was rejected and it was assumed that a definite association exists between grade level and the responses to the inventory.

4. Reading achievement was more often significantly associated with responses to The Reading Interest Inventory than was intelligence quotient. However, the results do not provide a sufficient basis for rejecting the hypothesis of no relationship between these two variables and the Inventory as a whole.

RECOMMENDATIONS FOR FURTHER RESEARCH

Additional studies are needed to:

1. Develop techniques for validating interest inventories.

2. Examine an interest area in greater depth to find out what particularly interested the child and what other items he would add.

3. Compare the backgrounds of those children who express many interests with those who express few.

4. Compare the interests of children in the different media of communication.

5. Determine the extent to which teachers can effect an increase of interest.

6. Explore the specific meaning to children of their expressed interests and the ways in which these interests would operate when children were provided with various opportunities.

7. Determine if there are other home factors which might better reflect the child's background than did those used in this study. 185 pages. $2.45

1. Per cent figures refer to the mean per cent of "Yes" responses to the ten questions of the interest category.

The items following each abstract are: the number of manuscript pages in the dissertation, its cost on microfilm, and the Library of Congress card number. Enlargements 5-1/2 x 8-1/2 inches, 4 cents per page. No postage is charged if check or money order accompanies order.

EDUCATION, TEACHER TRAINING

AN EVALUATION OF THE EDUCATIONAL PROGRAM FOR STUDENTS FROM FOREIGN COUNTRIES: EMPHASIS UPON ORIENTATION PROCEDURES, INDIVIDUAL PROBLEMS, AND PSYCHOLOGICAL VARIABLES

(L. C. Card No. Mic 58-1174)

Ralph Carl Bohn, Ed.D.
Wayne State University, 1957

Supervisor: Dr. G. Harold Silvius

This study was designed as a pilot investigation into the effectiveness of the foreign student program directed by the Technical Training Section of the United States Office of Education and financed by the "Point Four" Program. In general, the group evaluated consisted of industrial and general education teachers and administrators from Asia, Africa, and South America who were studying in educational institutions in the United States in an effort to improve the educational programs of their own countries. Their stay in this country varied from a few months to four years, but generally consisted of one year's study at one or two educational institutions.

The evaluative methods consisted of studying thirty-six students (10 per cent of those in the country during the time the study was conducted) through the use of the following instruments:

1. Language tests developed by the Committee on Diagnostic Reading Tests, Inc.
2. California Test of Mental Maturity.
3. Attitude scale based on Stephenson's Q-technique.
4. Questionnaire to faculty advisors.
5. Interview of students.
6. Questionnaire anonymously completed by the students.

These instruments were administered to the students while they were assembled at an educational seminar during the 1955 summer session at Wayne State University.

When the information collected through the use of the evaluating instruments was analyzed, the following findings appeared:

1. The students consistently rated below college freshmen in all types of language ability. This weakness in language ability was shown by the language tests and corroborated by the faculty advisors and by the students themselves. Because of the effects of this language deficiency, the California Test of Mental Maturity provided little or no information relating to the native ability or intelligence of the students.
2. If the California test is viewed as one of performance rather than native ability, the low scores received on the test indicate the foreign students were not able to compete with American students in many abilities necessary for efficient classroom learning.
3. The students held attitudes which tended to be favorable toward the United States and toward permissive rather than restrictive education.
4. The grades received by the foreign students were equal to or better than the grades of American students. In most cases, however, the foreign students were graded on a special scale and did not compete with American students.
5. The group under study was primarily composed of present or future administrators of industrial or general education. The median age of only thirty-four indicated that this group could influence the educational structure of their countries for many years to come.
6. The major problems encountered by the foreign students while in the United States were inability to use the English language, inability to adjust to American food, inadequate housing during the summer seminar, and inability to adjust to the different climatic conditions.
7. In evaluating the program of the school which the foreign students attended for the major portion of their education, one-third indicated that the educational program had failed to fulfill either their own personal objectives or the original objectives established for study in the United States. The major causes of this failure were misunderstanding between the sending country, the Office of Education, and the student; misinterpretation of curriculum offerings; and lack of adequate facilities for learning highly specialized activities.

During the evaluation, many additional factors were discovered which provided a more complete understanding of the educational program under study. These findings may be found in the individual chapter summaries and final chapter of the dissertation. 361 pages. $4.65

THE PREPARATION OF INEXPENSIVE AUDIO-VISUAL TEACHING MATERIALS, A COURSE FOR TEACHERS AT WAYNE STATE UNIVERSITY

(L. C. Card No. Mic 58-1186)

Daniel Harold Bowman, Ed.D.
Wayne State University, 1957

Supervisor: Dr. J. J. McPherson

There is evidence that professional educators are becoming aware of the potential contributions of locally prepared audio-visual teaching materials to the overall objectives of education. Perhaps the three major values of teacher and/or student prepared materials are: (1) an improved classroom climate, one that recognizes and provides for individual differences, (2) the availability of additional learning materials, particularly those pertaining to the local situation or to specific teaching methods, and (3) the materials to help promote a good school-community relationship. However, to other teachers the improved quality of teaching materials or the time saved by permanent preparation may outweigh some of the first three values listed.

In view of the increased interest in locally prepared materials, the primary purpose of this study was established as the reorganization of the beginning course in the production of instructional materials offered by the Department of Audio-Visual Education at Wayne State University.

The need for this study was developed from an examination of the records of the department and from a consideration of the type of student who takes work in the department. The design used for the study is generally typical of the design used in curriculum research.

Once the need for course change was established it became necessary to determine the type of training that is more desirable. To establish a broad perspective of the field, a list of the materials that teachers should be able to prepare was developed from the literature. In an effort to meet the local needs, similar information was obtained from a group of local teachers and also from some of their administrators and supervisors.

The information obtained from these three sources was consolidated into a master list. In frequency of mention the types of materials recommended for teacher and/or pupil preparation were: (1) recorded materials, (2) graphic materials, (3) duplicated materials, (4) three-dimensional materials, (5) projected materials, and (6) display materials.

Since many of these materials require common skills in their preparation, the course was planned in terms of skills rather than end products. The skills identified as significant are presented alphabetically: (1) arrangement and layout, (2) duplication, (3) enlarging, reducing, and transfer, (4) lettering, (5) mounting, (6) recording, and (7) simple construction.

A pilot or experimental class was offered during the spring semester of 1955-56. As expected, the first efforts had some weaknesses that became apparent as the class progressed. Additional changes were suggested by the staff and students.

The course was revised and a detailed outline for the revised course was prepared. Due to changing needs and varying interests of the students, only six fundamental skill areas were covered in preplanned and outline form. These six areas were arranged for presentation in ten sessions. While the writer suggested various possibilities, the five remaining sessions were left free for use in a variety of ways at the discretion of the instructor.

The evidence as to how well the revised course met the needs of both students and the Department of Audio-Visual Education is presented and analyzed. While the evidence available cannot be offered in the form of exact statistical answers, it does provide a basis for concluding that the course met the needs of students who took it.

It should be stressed, however, that the problem of selecting content for a course in the preparation of inexpensive teaching materials is not static. And since it is not static, the writer hopes that all staff persons concerned with the instructional program will remain aware of the changing needs of the program and the need for continuous study. 235 pages. $3.05

A FOLLOW-UP OF UNIVERSITY OF OKLAHOMA DOCTORAL GRADUATES IN EDUCATION -- 1931-56

(L. C. Card No. Mic 58-590)

Clarence Charles Clark, Ed.D.
The University of Oklahoma, 1957

Major Professor: Claude Kelley

This investigation was a follow-up of 134 individuals who have received either the degree of Doctor of Education or Doctor of Philosophy with a major in Education from the University of Oklahoma from 1931 through 1956. The purposes of this study were (1) to discover what has happened to the graduates professionally since receiving the doctorate in education; (2) to make available information concerning the educational and professional background of these doctoral graduates; (3) to determine what strengths and weaknesses the graduates identify in their programs of graduate study; and (4) to ascertain the graduates' opinions as to the assistance in achieving professional success which they have received from the University since the doctorate was conferred.

The data for this study were obtained from records in various offices of the University and through the use of a questionnaire sent to each graduate included in this study who was still living. Seven of them were known to be deceased and three could not be located. Completed questionnaires were returned by 90 of the doctoral graduates, which amounted to 72.6 per cent of the recipients of the inventory. The findings:

1. Of all the doctorates in Education conferred by the University of Oklahoma since the first, in 1931, 87.3 per cent were Doctor of Education and 12.7 per cent were Doctor of Philosophy degrees.

2. Educational administration and secondary education constituted the major fields of specialization in 72 per cent of the cases.

3. The median age of the graduates at receipt of the doctorate was 41 years. The youngest was 28 and the oldest 62 years of age.

4. In 1956, 60 per cent of the respondents were employed in college positions and 24.5 per cent in public schools.

5. The respondents, generally, were well pleased with their graduate study at the University of Oklahoma.

6. A large majority of the respondents expressed satisfaction with the following aspects of their graduate study: method and procedure used in the selection and admission of candidates to the program, course offerings, library facilities, the dissertation experience, and quality of instruction.

7. The respondents were most critical of the necessity of satisfying certain undergraduate deficiencies while doing graduate study. A reading knowledge of a foreign language was not only considered unimportant by 84.0 per cent of the respondents employed in college positions and 88.2 per cent of those in public school work, but also 83.2 per cent had never had use for foreign language.

8. The ability to speak effectively in public was considered essential or valuable in their present positions by 97.4 per cent and desirable to perfect in graduate study by 88.4 per cent of the respondents, yet 35.1 per cent felt that little or nothing was done to foster improvement.

9. Competencies considered most essential and valuable to the respondents were those associated with administrative and professional relationships, teaching, and professional development.

10. Slightly less than one-half of the respondents were satisfied with the assistance toward achieving professional success provided them by the University since they received the doctorate and 39.7 per cent felt they had received little or no assistance. 164 pages. $2.15

THE BACKGROUND, EXPERIENCE, PRESENT STATUS, AND SELF-APPRAISAL OF THE COLLEGE TEACHER OF EDUCATION IN MICHIGAN

(L. C. Card No. Mic 58-907)

Paul Henry Emerich, Ph.D.
University of Michigan, 1957

Statement of the Problem

The purposes of this study were: (1) to determine the background, educational preparation, previous educational experience, status, and present position of college teachers of education in Michigan; (2) to study the teacher's own appraisal of satisfactions and dissatisfactions in college teaching; and (3) to make comparisons of data gathered in Michigan, Wyoming, Ohio, and Minnesota.

Procedure

The questionnaire method was used in this study. The questionnaire used was developed by the Executive Committee of the National Society of College Teachers of Education.

Colleges represented in the study were selected according to specific criteria: (1) They were regionally accredited institutions of higher education. (2) They provided programs of teacher education which satisfied state certification standards.

Findings

There were 668 faculty members in the states of Michigan, Ohio, Wyoming, and Minnesota who participated in the study. The following characteristics typify the group as a whole:

1. More than 50 per cent of the college teachers of education were between the ages of thirty-five and forty-nine.
2. Fifty per cent were born in the Midwest, the geographical area in which they were teaching.
3. Undergraduate work was done with greatest frequency in a public or private university. Liberal arts colleges and teachers colleges ranked next in order.
4. Only 7 per cent of the respondents were without experience in either elementary or secondary school teaching.
5. Three out of four faculty members had had more than five years' experience on college faculties.
6. The decision to enter college teaching as a profession was made in mature years. Fewer than one out of five made this decision prior to graduation from college. The majority made this decision either as graduate students or else after extended experience in teaching.
7. If the respondents had the opportunity to make a vocational choice again, 80 per cent would choose college teaching in education. Only 7 per cent stated they would definitely enter another field.

The 261 Michigan college teachers of education furnished more complete data than were available from the other states involved in the study. Some of the findings concerning Michigan college teachers of education were:

1. Two-thirds of the college teachers of education in Michigan held doctorates; more than 97% held master's degrees.
2. Eighty per cent of the Michigan College teachers of education devoted more than 40 per cent of their professional time either to teaching or to preparation for classroom teaching. Forty-four per cent spent at least 60 per cent of their time in teaching activities.
3. The median interval of time devoted to counseling and student activities fell between 10 and 20 per cent.
4. Many satisfactions are associated with college teaching in education. The most frequent satisfaction expressed centered around a feeling of service and the enjoyment of observing and promoting student growth.
5. The most frequent dissatisfaction expressed was with the overly long hours required to carry out the responsibilities demanded of college teachers.
6. The median salary for college teachers of education in 1954-55 fell within a class interval of $7,000 to $7,999.

The striking fact about comparisons between the four states involved in the study was the remarkable similarity in the characteristics of faculty members. Departures from the pattern occurred most frequently in Wyoming.

A general conclusion is that college teachers of education are well qualified in terms of professional preparation and experience. There is a high level of satisfaction with the field of college teaching in education. 193 pages. $2.55

EFFECTIVENESS OF MUSIC TEACHERS IDENTIFIED THROUGH BEHAVIORAL CRITERIA: A BASIS FOR REDIRECTION IN TEACHER EDUCATION

(L. C. Card No. Mic 58-1177)

Winnifred L. Fenton, Ed.D.
Wayne State University, 1957

Supervisor: Dr. L. N. Nicholas

The purpose of the study was to determine the effectiveness of music teachers as identified through behavioral

criteria. Data were obtained through observations of the music teachers in functional situations. From these observations a list of effective behaviors of the music teacher was formed.

The critical incident technique was used in the study. The respondents, including music students, music teachers, music supervisors, those engaged in music education in colleges and universities, principals and superintendents, were asked to report an incident in which they observed a music teacher engaged in an effective or ineffective activity. In requesting the critical incident from the respondent, conditioning data were obtained in regard to his sex, age, education, type of position, and years of experience.

As the incidents were received, they were analyzed and formed into categories and subclasses. The data sheets were coded and all the information statistically analyzed. Seven hundred incidents were used in the study; approximately half were reports of an effective activity. The incidents were equally divided between male and female respondents. The majority of the respondents were over forty years of age and had over fifteen years of experience. Over fifty per cent of the respondents had a Master's or Doctor's Degree. Their positions were: Administrators twenty-nine per cent; music supervisors sixteen per cent; music teacher educators seventeen per cent; and music teachers fifteen per cent.

From the categories and subclasses a list of behaviors of the effective music teacher was formed. Summarized in their rank order of frequency of mention, these are: (1) The music teacher uses skill in motivation of the learner through praise and reassurance, through purposeful techniques, and through the presentation of information of interest to the learner. (2) The music teacher possesses personal qualities for leadership: stability, reliability, objectivity, and ability and skill in music. (3) The music teacher is skillful in following the learning process; she is flexible, creative, and a good organizer. (4) The music teacher is skillful in providing for the individual needs of the learner. She gives encouragement, understanding, and special help when needed. (5) The music teacher provides democratic leadership; she encourages pupil participation and interaction. (6) The music teacher is skillful in the selection of learning experiences that have continuity, pupil interest, variety, and that meet the needs of all of the learners. (7) The music teacher is skillful in setting and defining goals; she motivates the pupil to establish his own goals. (8) The music teacher works effectively with the local community, the administration, and with her school community.

The list of effective behaviors may have value as a basis for redirection in pre-service and in-service education of the music teacher, or in recruitment, selection, placement, and evaluation of the music teacher.

228 pages. $2.95

FOLLOW-UP PROGRAMS IN TEACHER-EDUCATION INSTITUTIONS IN THE UNITED STATES

(Publication No. 25,465)

Lynn Norman Nicholas, Ph.D.
The Ohio State University, 1951

The problem of the successful induction of beginning teachers into their chosen profession and of helping them to become better teachers during the next several years of their experience is most vital. The loss to the public because of resignation or failure of many beginning teachers is significant. The public has spent thousands of dollars, through taxation, endowments, and other gifts, to prepare these young people for teaching in public and private institutions. These prospective teachers proved their scholarship and interest in children during their four-year college courses. But often the serious and conscientious student is lost to the profession because he is unable to cope with the many perplexing problems that confront him on every side when he starts teaching. The beginner recieves no help in many cases. In other cases, an unsympathetic supervisor or administrator often makes him more discouraged, less secure, and more tense in attacking his problems.

Teacher-education institutions should assume as an important part of their obligation the follow-up of recent graduates, cooperation with the public schools in inducting these graduates into the profession, and the continuous evaluation of the teacher-education program so that it may meet more adequately the needs of the students in the public schools. The present study involves the following major questions as they relate to this problem: (1) What are the follow-up activities in the teacher-education institutions of the United States? (2) What suggestions have the teacher-education institutions for a follow-up program? (3) What are the suggestions of public school supervisors, principals, superintendents, and teachers for a follow-up program by teacher-education institutions? (4) What would be a deisrable state-wide follow-up program for the state-supported teacher-education institutions? (5) What recommendations can be made for the implementation of such a program?

Data were secured by means of two questionnaires. Copies of one form were sent to 259 teacher-education institutions in the United States, and copies of another form were sent to 150 teachers, 100 principals, and 100 superintendents, distributed evenly among the county, exempted-village, and city schools of the state of Ohio. Responses were received from 77 per cent of the teacher-education institutions in all but three states. Of the responses of the teachers, 79 per cent were usable; of those from supervisors and principals, 72 per cent were usable; and of those from superintendents, 76 per cent were usable.

The following pages include the findings of the study and the recommendations made by the investigator.

Follow-up Activities Reported by 200 Teacher-Education Institutions

1. The responsibility for follow-up activities was delegated most often to the director of student teaching and/or director of placement. 2. Approximately two-thirds of the institutions used part-time staff members in

the follow-up program, participation being spread widely among the staff. 3. The median amount of time given to follow-up activities was the equivalent of one full-time staff member. 4. The cost of the follow-up programs varied from $100 in one institution to $12,000 in another, the median being $2,750. The median amount per graduate expended was $24. 5. Approximately one-half of the institutions followed up their graduates through correspondence the first year after graduation; less than one-eighth continued after the first year. 6. The placement officer was charged with the responsibility in most cases for initiating correspondence with or about the recent graduates. In many institutions this was the only follow-up practice. 7. Correspondence was mailed to an administrator from 60 per cent of the institutions, to an administrator and the teacher in 31 per cent of the institutions, and to teacher alone in 2 per cent of the institutions. 8. Replies from correspondence were used mainly in placement and in evaluating the college curriculum. 9. A special effort was made by 86 per cent of the teacher-education institutions through visitation, correspondence, reports from the administrator or teacher, and campus conferences, to find those graduates experiencing difficulty. 10. The means of helping those graduates experiencing difficulty, when personnel, finances, and distance permitted, was to visit and confer with the teacher and administrator. 11. College staff members visited a very small percentage of the graduates during or after the first year of teaching. 12. The graduates in the field were visited by teaching staff members during every season of the year in a majority of the teacher-education institutions. 13. While visiting the school, the college representative almost always conferred with the teacher and the administrator, and observed the graduate's teaching. 14. After being visited, the graduates were helped through counseling and correspondence and the provision of curricular materials and directed readings. 15. Only in West Virginia and Oregon did the institutions attempt regional coöperative planning in which each teacher-education institution was responsible for the follow-up of all beginning teachers within its area. 16. Graduates were invited back to the campus for a one-day follow-up meeting on Friday or Saturday during the first year in one-fourth of the 200 institutions reporting, and after the first year in less than one-eighth of them. Activities included conferences with staff members; round-table, panel, and general discussions; visits to laboratory schools; discussion of problems proposed by graduates; speakers; luncheons; and social get-togethers. Usually the graduate paid his own expenses. 17. Ten schools provided follow-up through a period of internship for graduates who had met all requirements for certification. 18. Sixty-two institutions planned to initiate campus follow-up conferences and/or visitation of graduates. 19. Major benefits of follow-up activities according to the institutions were that they helped the beginning teacher to succeed; they improved the teacher-education program through continuous reappraisal; they fostered a coöperative relationship with the graduates and the public schools; they improved the quality of teaching; and they facilitated placement of graduates.

Suggestions for a Desirable Follow-up Program by the Teacher-Education Institutions, Teachers, Supervisors, Principals, and Superintendents

1. The value to the teacher-education institutions of a follow-up program which all groups listed most frequently was the opportunity it provided to evaluate and improve the teacher-education program in terms of the needs of the public schools and to promote integration with the public schools. 2. Such a program for the public schools was listed by all groups as being valuable because it improved instruction, aided in the induction of new teachers, and led to closer coöperation with the colleges. 3. The values for the graduate which all groups listed were aid in adjustment to teaching, greater success in the first year of teaching, a sense of security through counseling with former instructors, and a feeling of confidence that friendly help was available. 4. Two-thirds of all the groups believed that an institution should follow up its graduates for one or two years. 5. One or more visits per year to each graduate was desirable, according to a slight majority of all the groups. 6. Teachers, principals, and superintendents thought that a full-time director should be responsible for the follow-up program, but the institutions were in favor of having the director of student teaching in charge of it. 7. Wide participation of college staff members in the follow-up program was thought desirable by most of the respondents. 8. Correspondence should be carried on with the graduate and the administrator in charge during and after the first year of teaching. The majority did not designate any particular season of the year for conducting the correspondence but the teachers thought that winter was the best time for it. 9. In the opinion of more than 90 per cent of all the groups, teacher-education institutions should try to determine which new teachers are experiencing difficulty, and the public schools should be free to request assistance for a recent graduate who needs help. 10. The college representative should visit the graduate during the first year; and after the first year visitations should be made during the winter, according to the teachers and administrators, and during the fall, according to the institutional leaders. The college representative should observe the graduate's teaching and hold a conference with the graduate's administrator, according to approximately 90 per cent of all the respondents. 11. Help should be given to the graduate subsequent to the visitation through personal conferences; written suggestions as to books, materials, and procedures; conferences of teacher, administrator, and college representative; observation of outstanding teachers; and invitations back to the campus for follow-up meetings. 12. A majority of the institutions, teachers, and administrators opposed a coöperative area plan of follow-up. 13. Eighty-two per cent of the 435 respondents thought that graduates should be invited back to the campus, preferably during the spring or winter, for follow-up meetings during and after the first year. The institutions preferred fall; the teachers and principals, spring; and the superintendents, winter. Planned activities should include round-table and panel discussions, workshops based on graduates' problems, conferences on specific topics, personal conferences, observation of campus-school activities, and special speakers. 14. Fifty-five per cent of 372 respondents thought that the public school should pay a part of the expenses incurred by the graduate in attending campus meetings for one or two days. 15. Programs similar to those for campus meetings were suggested for area or district follow-up meetings by approximately two-thirds of those responding. 16. A majority of the respondents approved a one-year period of organized internship with credit as a part of follow-up for graduates who have met all requirements for certification. 17. An alumni bulletin or news letter for graduates,

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containing professional materials, readings, teaching aids, research, and new developments in curriculum revision and teaching techniques, was suggested by 80 per cent of those responding. 18. Problems that might arise in the process of administering a follow-up program were those connected with finance, personnel, and coöperation among the colleges, schools, and the state department. Their solutions would depend upon financial help contributed by the state or jointly by the institutions and the schools, additional personnel, good public relations, and careful selection of teachers.

A Desirable Follow-up Program for State-supported Teacher-Education Institutions

A follow-up program for state-supported teacher-education institutions is presented by the writer. The justification for including only the state-supported teacher-education institutions is that these institutions have an obligation to all children of the state. They have a duty to provide the best possible teachers for as many classrooms as possible and to experiment with better methods to narrow the gap between theory and practice.

Possibly all the activities suggested cannot be undertaken immediately, but the following program should serve as a guide to the state-supported and other institutions striving to induct new graduates into their chosen profession more successfully.

1. The follow-up program in large institutions should be conducted by a full-time director of follow-up, as chairman; the director of student teaching and the director of placement, as members; and two members appointed by the dean on a rotating basis. 2. In smaller institutions, the follow-up program should be conducted by the director of student teaching, as chairman; the director of placement, as a member; and a third member appointed by the dean on a rotating basis. 3. A staff member from each institution should visit all of its graduates who are teaching in the state, possibly making a second visit and having personal conferences on the campus with those having serious difficulty. The supervisor of student teaching is the most logical person to make the visitation. 4. The director of placement should be responsible for follow-up by correspondence.

a. In November and December he should carry on correspondence with administrative heads of the schools about the success of recent graduates. The information should be recorded in the placement office and reported to the follow-up committee and the dean.

b. School administrators should be encouraged to notify the placement director about any graduate having unusual difficulty in adjusting to his first position.

c. He should secure a rating of teaching success for each graduate from the local administrator in the spring of the first year of teaching as a follow-up of earlier reports.

d. Correspondence with the graduates should cover ways in which they could be helped to improve their teaching.

5. The director of follow-up or the director of student teaching should arrange for visiting the graduates during the winter and early spring. 6. The college representative should observe the graduate's teaching and confer with him and with his administrator. 7. To the degree that it is needed, help should be given the graduate after he has been visited. 8. Organized follow-up campus meetings should be planned for the spring of the year at each institution.

a. The state should be divided into sections, each state institution being a center, and all beginning teachers in that area should be invited to the campus.

b. All colleges having recent graduates teaching in each section should be invited to send representatives to the sectional follow-up conference.

c. The conferences should be for one day, preferably on Friday, and all beginning teachers should be excused from teaching duties for the day and allowed money for conferences expenses by the board of education.

d. The programs should be planned to help the new graduates, providing opportunities for personal conferences, discussion groups, and other desirable activities.

9. The state-supported institutions should explore the desirability of a period of internship after graduation. If a fifth year for a period of internship is not feasible, the institutions might consider a full-time period of internship during the senior year. 10. An alumni news letter containing professional materials, readings, teaching aids, new developments in curriculum revision and teaching techniques, and information about the graduates would be of great interest and assistance to all alumni in teaching. 11. The problem of coöperation among the groups can be solved by good human relations and an educational program stressing the benefits to be derived from a desirable follow-up program. 12. If an institution similar in size and location to the Ohio State University is to provide an adequate follow-up service, it should spend the following amounts per year: personnel, $10,000 to $12,500; travel, $1,000; lodging and meals, $4,000; correspondence, $500; and campus follow-up conferences expenses, $500: a total of from $16,000 to $18,500. On the same basis, the expenditures for all the state-supported institutions in Ohio should be approximately $65,000 a year - $21 a graduate. 13. There should be closer coöperation among the teacher-education institutions and the public schools in helping the recent graduate through a well-organized follow-up program. These groups should consider in their regular professional meetings means of satisfying the needs of beginnning teachers in the public schools. The state department of education should set up conferences in each section of the state to which representatives of all groups would be invitied for the purpose of exploring this problem thoroughly. 14. Educational leaders should consider the advisability of granting a new graduate a one-year provisional certificate with the regulation that a four-year certificate be granted at the end of the first year of teaching upon the recommendation of the college and the local administrator after the various follow-up activities have been completed. This would require the college to continue its interest in the new graduate, for it would have to send an evaluation to the state department at the end of the first year. The graduates would be interested in securing assistance and in achieving greater success because of the evaluation by the college representative and the public school administrator. 15. The state legislature should appropriate approximately $21 per graduating senior per year for a biennium to make an experimental approach toward setting up an organized follow-up program

The items following each abstract are: the number of manuscript pages in the dissertation, its cost on microfilm, and the Library of Congress card number. Enlargements 5-1/2 x 8-1/2 inches, 4 cents per page. No postage is charged if check or money order accompanies order.

for the state-supported teacher-education institutions in coöperation with the public schools of the state.

247 pages. $3.20. Mic 58-4814

Abstract published by special arrangement with The Ohio State University.

CURRICULUM IMPLICATIONS EMERGING FROM A STUDY OF RECIDIVISTS AT THE STATE HOME FOR BOYS, JAMESBURG, NEW JERSEY

(Publication No. 22,575)

Gertrude Burke Schmidt, Ed.D.
Rutgers University, 1957

The Problem

This study, which deals with the behavioral characteristics of third-time offenders in the State Home for Boys, Jamesburg, New Jersey, had a two-fold purpose: (1) to identify factors associated with delinquency behavior which lead to continued maladjustment and delinquency, (2) to suggest, on the basis of the analysis of these factors, kinds of curriculum emphases which need to be recognized if a corrective institution is to restore recidivists to society.

The Procedure

The case study method was employed for the investigation of offenders who were committed to Jamesburg three or more times. After developing an inventory of information needed, personal files of fifty recidivists were examined. From these files, adjustment histories and personal and social feelings and attitudes were obtained plus general information on commitment age, family background, home conditions, intelligence, and offense. Charts were devised to record the following behavioral characteristics: feeling of security, attitude toward authority, status preservation, feeling of difference, temperament, reaction to failure, and feeling of adequacy.

From the fifty cases, fifteen were selected for more intensive study. The reactions of these boys to their school assignments were obtained by remaining with the recidivists for long periods of time and following them through their daily assignments. Their feelings were recorded in anecdotal records, autobiographies, and interview reports. Visits with parents and teachers followed this intensive study. Sociograms revealed group patterns of relationship. Through the "shadow" method, it became possible to study the recidivists' actual experience as the boys saw these experiences.

To show the results of this survey in definite terms, a composite portrait of one recidivist, Jimmy, was portrayed. He did not depict any single Jamesburg recidivist but represented the complex of traits and experiences frequently appearing in the real lives of the fifteen inmates.

Through these procedures, the investigation unearthed deficiencies in the behavioral characteristics of recidivists for which the school curriculum must compensate. By studying research on principles, methods, and laws of learning, a type of curriculum approach needed for boys lacking these characteristics was determined.

Conclusions

The factors associated with delinquency behavior which led to continued maladjustment and delinquency were identified. These recidivists lacked security and belonging. They were resentful and rebellious toward authority. To maintain status, they did not confide in anyone. They wished that their familes were harmonious and stable. In temperament, the boys gained attention by stealing and running away. These boys who felt inadequate and rejected hid defeat in a new reaction.

The intensive study of the fifteen recidivists revealed that they required a school program designed to meet their needs and problems and to assist them in successfully withstanding their poor home environments. The program should increase their attention span, assist them in reaching their full intellectual capacity, and help them to overcome their behavioral deficiencies and their dislike for school. This curriculum requires provisions for socialization and training in democratic living. For this program to succeed, the study revealed the need for firm discipline which could be achieved by maintaining consistent standards among personnel who are democratically organized.

Implications

A community school approach is recommended which utilizes the experience-centered curriculum relating subject matter to actual institutional experiences and to the lives and motives of recidivists. Also recommended is the replacing of the graded school organization with broad units in which groups democratically select and study experiences based upon personal, social, community, and socioeconomic problems. Evaluation based upon behavior and adjustment must be continuous.

205 pages. $2.70. Mic 58-4815

THE LONG RANGE PRODUCTIVITY OF A SUBSIDIZED AND FORMALLY ORGANIZED ACTION RESEARCH CURRICULUM STUDY

(L. C. Card No. Mic 58-1185)

Sam M. Sniderman, Ed.D.
Wayne State University, 1957

Supervisor: Dr. Charles L. Boye

Purposes of the study--The major purposes of this study were to:

1. Determine the degree of permanence of change in the attitudes, understandings, and skills of the personnel involved in an action research project of curriculum development.
2. Determine to what extent the personnel involved in such a program of curriculum development are currently influencing the educational scene.

In order to accomplish the above purposes, this study attempted to answer the following:

1. After a given number of years, is it possible to identify the end products of a cooperative curriculum

study in the philosophy and methodology of those who actively participated in the study?

2. Is there a greater degree of movement toward professional improvement and professional participation in those who actively participate in the study?
3. To what degree is there greater upward status mobility among those who actively participate in cooperative school studies?

Design of the investigation--For the purposes of this investigation a foundation financed, action research curriculum development project, similar in objectives and methodology to a number of major curriculum studies conducted in the last quarter century, was chosen as an appropriate source of data. The study participants were classified as to extent of participation and data were secured from them by means of a modified questionnaire approach. An initial telephone contact was made with each respondent to help insure a valid return of the questionnaire.

Major conclusions--The conclusions are presented as they relate to the major purposes of this investigation. The first major purpose deals with the permanence of change in the attitudes, understandings, and skills of the personnel involved.

The data indicate a statistically significant and greater increase of interest in the specific activities of the experimental program among those who participated more actively in the program.

In addition, the data indicate that there was a statistically significant and higher retention of interest in the five years following the study among those who participated more actively in the program.

On the "How I Teach" scale those who participated more actively in the program scored a statistically significant and higher rating than those who were not as active.

In terms of increased formal course work those who participated more actively in the program indicated a statistically significant and greater increase in formal course work than those who were less active.

Based on the three factors indicated above, it is concluded that among the personnel who participated more actively in the action research curriculum development project investigated, a statistically significant and greater degree of permanence of change in attitudes, understandings, and skills, is found, when they are compared with those who were less active.

The second major objective concerned the extent to which active participants of the action research curriculum project are currently influencing the educational scene.

The data indicate a statistically significant and greater amount of professional participation on the part of those who participated more actively in the action research program when they are compared to those who were less active.

In terms of upward mobility, the data indicate a statistically significant difference between those who participated more actively and those who were less active.

In terms of the above data, it is concluded that there is a statistically significant difference in degree of influence on the current educational scene between those who participated more actively in the action research curriculum development project as compared with those who were less active.

A summary profile based on the original data and the conclusions drawn clearly indicate a high degree of association between active participation in the action research project and a retention of a high degree of interest in the outcomes of the project, a high rating on the "How I Teach" scale, an increased amount of formal course work, increased professional participation, and upward status mobility within the profession. 120 pages. $2.00

EDUCATION, THEORY AND PRACTICE

PROBLEM ORIENTED TEACHING AND PUPIL ACHIEVEMENT IN VOCATIONAL AGRICULTURE

(L. C. Card No. Mic 58-1103)

Dale Walker Andrews, Ph.D.
University of Minneosta, 1957

Purpose. The purposes of this investigation were: (1) to determine whether there were significant differences in pupil achievement and in change in pupil attitude for the pupils studying under teachers "most" and teachers "least" oriented toward basing Vocational Agriculture Science II instruction on the problems provided by the supervised farming programs of their pupils. (2) to determine whether a significant relationship existed between teacher orientation and the nature and extent of the supervised farming opportunities of the pupils. (3) to survey the status of problem oriented teaching in vocational agriculture on the sophomore level in California.

Method. A fifty-item Opinionnaire on Problem Oriented Teaching in Vocational Agriculture (Reliability Coefficient by Hoyt-Stunkard method = .91) was developed by the investigator for use in ascertaining teacher orientation. A 95 per cent return of opinionnaires from 113 California Vocational Agriculture departments appearing in the fifty per cent random sample, proportionally stratified on the basis of the seven California supervisory regions, was obtained. The achievement and attitude results for the pupils of the 25 highest scoring or most problem oriented teachers (group M) and the 25 lowest scoring or least problem oriented (group L) were selected for comparison.

The criterion of pupil achievement used was measured pupil status at the end of the six-month study period, holding constant the factors of mental ability and initial status. Pupil status was measured by the Achievement Test for Sophomores in Vocational Agriculture. This test constructed specifically for this study by the investigator in its final form gave a coefficient of reliability of .83 using the Hoyt method. The California Capacity Questionnaire was used to secure a measure of mental ability on all pupils participating.

Tally totals taken from separate two-dimensional tables yielding gain, no change, and loss figures by group (L or M) for each item of the Attitude Inventory for Pupils in Vocational Agriculture provided the basis for comparing changes from the first to second administration.

The statistical techniques used were the chi-square

test, the t-test, Dixon's test for extreme mean, and the complete analysis of variance and covariance.

Findings. The general conclusion was that the Vocational Agriculture Science II pupils in the classes that were measured, and in respect to the things measured by the achievement test, were doing just as well under the teachers in group L as were the pupils under the teachers in group M. In spite of the absence of significant findings favoring either group, it would seem that these findings are favorable to the teachers most problem oriented, and were not those anticipated a priori, because for group L teachers the criterion of pupil achievement used (a strictly subject-matter test) should be their forts.

Neither of the two teacher orientations resulted in a significantly greater change in pupil attitude, as measured by the attitude inventory items during the period of the study. Those in group M did tend to make more gains and fewer losses but these differences were not enough to be significant. One item which dealt with how interesting the boys found Vocational Agriculture Science II fell just short of being significant at the .05 level.

No evidence was found to demonstrate a significant association between the seven California supervisory regions and the opinionnaire scores received by the teachers. Evidently the seven groups of teachers came from the same population as regards their orientation toward basing their Vocational Agriculture Science II program on the problems provided by the supervised farming programs of their pupils.

The opinionnaire responses of the Vocational Agriculture Science II instructors were summarized in table form. The more interesting response patterns concerning the status of problem oriented teaching on the sophomore level in California was noted. 239 pages. $3.10

THE DEVELOPMENT AND APPLICATION OF A METHOD FOR EVALUATING DEFINED PHASES OF STUDENT ACTIVITIES PROGRAMS IN INSTITUTIONS OF HIGHER EDUCATION

(L. C. Card No. Mic 58-1179)

Joseph E. Hill, Ed.D.
Wayne State University, 1957

Supervisor: Dr. J. W. Menge

Purpose

The purpose of this study was to develop a methodology for evaluating the need, scope, operation, and implementation of program segments composing a general student activities program in institutions of higher education. Further, the proposed methodology was to be designed in a way that would permit successful application by an individual member or group of persons selected from the student body, faculty, administration, or any other component part of the institution's community population.

General Plan

The general plan of the study was carried out by: (a) introducing the problem through discussion of the need for the study; (b) substantiating the philosophy underlying the proposed methodology; (c) justifying the forced-choice rank-ordering type questionnaire employed by the methodology; (d) discussing the sampling procedures of the methodology, including the aspects of "adequacy," "representativeness," and "allocation of a fixed sample size over a given number of strata"; (e) developing a "routine" for treatment of the data by applying Analysis of Variance, Single Classification; (f) recommending a procedure for reliably interpreting the data; and (g) illustrating the methodology with practical examples throughout the study, and demonstrating it in totality by applying it to a self-evaluation study of the Wayne State University Interfraternity Council.

The major results of the study were presented in the form of detailed and analytical description of specific procedures for (a) selecting and defining problems to be studied, (b) analyzing the problem area, (c) running a pilot study and determining size of sample needed for the main study, (d) analyzing the data, and (e) reporting and recommending.

Summary of the Proposed Methodology

The proposed methodology is composed of four general phases. Phase A (Procedures of Organization and Orientation) covers the duties of the commissioning agency, the appointment and orientation of investigatory personnel, and the individual investigator's responsibility for informing himself about the problem area. Phase B (Problem Area Analysis and Gathering of Data) deals with analyzing the problem area, methods of data-gathering, the pilot study, determining a minimum sample size at a given level of confidence, and the administration of the data-gathering instrument. Phase C (Treatment of the Data) includes "scoring" the questionnaire and intra-stratum, inter-strata, and trend analyses of the data. Phase D (Procedures of Reporting and Recommending) deals with decisions, recommendations, the written report, qualifications of the reporter, and provision for future studies.

Application of the Methodology

One of the significant aspects of this study is demonstration of the applicability of research and statistical theory to actual educational problems in such a way that research methodology rightly becomes a tool for solving real problems. This was demonstrated in the application of the methodology to the Wayne State University Interfraternity Council Self-Evaluation Study. The faculty with which three students and a faculty member conducted the "prescribed procedures" in a problem area of twenty fraternities seeking answers to such questions as: "Why do we exist?" "What have we to offer?" "What are we doing?" and, "What should we be doing?"; plus the sampling of individual fraternity and non-fraternity students along the lines of: "Why did I join this fraternity?" "What am I getting out of it?" "What should I expect to get out of it?" "Why am I not interested in fraternities?" "Why didn't I pledge a fraternity?" gave adequate testimony as to the practicability, usability and workability of the proposed methodology.

Conclusions

This study presents a methodology for making a systematic attack on the problem of student activities program evaluation. It is a dynamic one that calls for active analysis instead of passively suggesting criteria for program

The items following each abstract are: the number of manuscript pages in the dissertation, its cost on microfilm, and the Library of Congress card number. Enlargements 5-1/2 x 8-1/2 inches, 4 cents per page. No postage is charged if check or money order accompanies order.

evaluation. The proposed methodology is not a panacea, but represents a move in the direction of more appropriate use of the tools of research in appraising student activities.
324 pages. $4.15

RELATION OF CERTAIN SELECTED FACTORS AMONG CONNECTICUT SCHOOL TEACHERS TO STATUS LEADER ROLE EXPECTATIONS

(Publication No. 23,104)

Philip Langer, Ph.D.
University of Connecticut, 1957

The study attempted to abstract the concept of the social process in supervision among teachers, and to determine the bases of such expectations.

Based on an analysis of small group leadership, and a theoretical development of role, the following hypotheses were postulated concerning role expectations:

1. There is no significant difference between the role expectation scores for men and women teachers.

2. Role expectation scores among men and women teachers can be related to their personality traits.

2.a. The combination of significant personality traits within each sex will be different.

2.b. If a personality trait is common to both sexes, it will be of a different magnitude and/or direction for each sex.

3. Role expectation scores among men and women teachers cannot be related to their own level of education and/or years of teaching experience.

Role expectation scores were defined as the number of recorded preferences for social interaction decisions in paired-choice with non-social interaction decisions. A social interaction decision is one in which fulfillment by the person(s) concerned definitely requires further meetings with the status leader, while a non-interaction decision does not definitely require such further meetings.

The personality traits are those measured by the Guilford-Martin Inventory of Factors GAMIN. These traits are presumed to be present in successful supervisors to a higher extent than unsuccessful supervisors.

To test these role expectations, a paired-choice test was devised. One of each decision-type (social and personal) was constructed from each of eight areas of educational practice. The subject matter bias was distributed according to chance. The two decision-types were matched in all possible combinations, save one: decisions from the same area were not paired off. Finally, the teacher was asked to select one decision from each and every pair in accordance with the following question:

"If you were principal, with which decision would you like to be associated?"

The paired-choice test and the GAMIN (in that order) were administered to teachers enrolled at the University of Connecticut. The results below are based on the scores of 78 men and 40 women.

1. There was no difference in the role expectation scores for men and women. In addition, the mean and median scores for both sexes were close enough to the theoretical mean-median to indicate no marked preference for either decision-type.

2. The internal reliabilities of the paired-choice test for men (.64) and women (.69) were used to correct for attenuation the product-moments below.

3. The role scores for men were significantly correlated with the ascendancy (A) trait; while the following traits were significant for women: masculinity (M), lack of inferiority (I), and lack of nervousness (N).

4. The role scores for both men and women could not be correlated with education and/or experience. In addition, the product-moments for just those men intending to become supervisors (N - 41) were not significant.

5. The intensity with which the social process is held does not appear to be a function of the area practice for men, while for women the reverse is true.

6. The validity of the test (i.e., measurement of the social process as a successful supervisory practice) is postulated on the establishment of positive significant relationships for both sexes between the role scores and the GAMIN traits.

All the hypotheses appear substantially verified except 2.b. It was concluded that:

First, the relationship between role expectations and personality traits would indicate that instruction concerning status leaders should be based around the individual teacher.

Second, less emphasis on supervision as a social process might result in greater group identification.

Third, the differences between men and women concerning the intensity of the social process and the nature of the practice might prove valuable in actual school operations.

Fourth, the present devices might best be used in examing the beliefs of teachers residing within a limited area.
135 pages. $2.00. Mic 58-4816

STRENGTHS AND WEAKNESSES OF SELECTED ELEMENTARY SCHOOL PROGRAMS IN OKLAHOMA

(L. C. Card No. Mic 58-593)

Kenneth Lloyd Lewis, Ed.D.
The University of Oklahoma, 1958

Major Professors: W. B. Ragan and Claude Kelley

Interest in the evaluation of the school program has increased considerably during recent years. Laymen have shown more interest in wanting schools to do an effective job of teaching. Teachers and administrators have sought ways to improve the educational product. A number of evaluative criteria and instruments for use by elementary schools has been published by state departments of education, associations of elementary principals, and school systems. A review of some of these instruments, published since 1948, is presented in the study.

The study reports the development of the Oklahoma Evaluation Manual for Elementary Schools, published in January, 1957, by the Oklahoma Curriculum Improvement Commission. From the use of this manual the study reports data of evaluations, needs for improvement identified

by teachers and principals, and suggestions for improvement of the evaluation manual. These data were provided by 141 Oklahoma public elementary schools who conducted a self-evaluation of their school during the spring semester of the 1956-57 school year. Returns of the evaluation manual from respondents were scattered among 30 of the 77 Oklahoma counties. Evaluative data from the 141 schools are stated in tables. Percentages of each evaluation for an item are indicated. The evaluation manual contained three major sections: (1) nature and purpose of the manual; (2) evaluative check lists under general operational practices and facilities; and (3) evaluative check lists for seven curricular areas. The section on general operational practices and facilities presented check list on Objectives of the School, Administration and Supervision, Curriculum Organization and Cooperative Planning, Pupil Personnel and Guidance Services, Classroom Organization and Management, the School Plant, and School and Community Relationships. The section on curricular areas presented check lists on the Arithmetic Program, the Program in Arts and Crafts, Health, Physical Education, and Safety, the Language Arts Program, the Music Program, the Science Program, and the Social Studies Program.

The strongest areas in the section on general operational practices and facilities were Administration and Supervision and Classroom Organization and Management; more than 70 per cent of the respondents generally evaluated items of these areas in the two higher evaluation categories. The weakest area, in this section, was the School Plant; twenty-eight per cent of evaluations for this area were placed in the two lower evaluation categories by respondents. Other areas included in this section of the manual were often evaluated as "above average."

According to evaluations of respondents, the strongest curricular area was Language Arts; sixty-eight per cent of the evaluators rated items of this area in the two higher evaluation categories. Arts and Crafts and Health, Physical Education, and Safety were the weakest areas of this section; twenty-one per cent and twenty per cent of the total evaluations of these areas, respectively, were placed in the two lower evaluation categories by the respondents. Other curricular areas generally received most evaluations in the "above average" category. 164 pages. $2.15

PERCEPTIONS OF ROLE DIFFERENTIATION CONCERNING SUPERVISORY PERSONNEL IN ART EDUCATION

(L. C. Card No. Mic 58-1273)

Bernice Bingham Loughran, Ed.D.
Stanford University, 1958

The purpose of this study was to examine the perceptions held, by art specialists and educators in general, of the roles inherent in art supervision. In the preliminary investigation three art supervisory roles were apparent: art director, art consultant, and school art resource person. These three principal roles have been called the "titular" roles. With this background it was hypothesized that each of these three titular roles has distinctive subordinate roles or competences that may be discerned by an examination of the activities actually and ideally assigned to each role.

The research design included a careful survey of relevant literature published during the decade 1947-1956. A check sheet was developed to obtain responses to educators' perceptions of the patterns of behavior and expectations attached to each of the three titular roles. Ninety activities were found to describe what art supervisory personnel might be doing. It was decided to use as a sample three groups of educators: art educators, general public school personnel (superintendents, principals, classroom teachers), and leaders in art education. A random sampling technique was used in the selection of educators to respond to the check sheet.

Fifty-one specialists and thirty-nine of the poeple in general education responded to the mail solicitation of 276 educators from various sections of the United States. Tabulation of the responses gave three categories of data for each item or activity included in the check sheet. These were: ideal titular role assignment of the activity, actual titular role assignment of the activity, and the frequency with which art specialists participate in the activity. The chi square formula was used to determine whether the distribution of response for each assignment was at least the .05 level of confidence for two degrees of freedom for each item. The median frequency was found for each item.

In terms of the items that make up the check sheet, two of the three types of art supervisory roles are seen to be distinct in both the ideal and the actual assignments: the art director and the art consultant. The art resource person is not seen as functioning in a distinctly supervisory capacity.

Areas of concern and responsibility for the three titular roles were discovered. The art director's role is primarily concerned with administrative activities, policy-making and public relations. The art consultant's responsibility centers in her work as guide and counselor to the teachers; either individually or in groups. The school art resource person is seen primarily as a teacher.

An examination of the literature and the unstructured comments from respondents, as well as the preliminary grouping of items on the check sheet, provided a list of ten subordinate roles for the three titular roles. They are: administrator, group leader of teachers, counselor to individual teachers, professional artist, editor, clerk, member of the central office staff, member of the art education profession, teacher and member of the community.

Among the more important findings was evidence that the general educator and the art specialists diverged in their perceptions of the actual role of art director. It was also found that many art consultants are at present required to participate in activities that are not in the ideal area of concern for that role. It was concluded that more effective communication and lessening of tension might result from a clearer perception of the art supervisory roles in the public schools of this country.

89 pages. $2.00.

THE RELATIVE PROGNOSIS VALUE OF SELECTED CRITERIA IN THE PREDICTION OF STENOGRAPHIC SUCCESS OR FAILURE IN SELECTED SECONDARY SCHOOLS IN ILLINOIS

(Publication No. 24,911)

Wilmer O. Maedke, Ph.D.
Northwestern University, 1957

The purpose of this study was to determine the relationships that exist between selected, objective indices of stenographic potential and subsequent achievement measured by first-year shorthand transcription test scores and second-year shorthand semester grades.

The subjects of the study consisted of 490 beginning shorthand students in 19 classes taught by 12 teachers in 7 selected high schools in Illinois.

The criteria selected for use in this study were: (1) the Turse Shorthand Aptitude Test; (2) scholastic grade-point averages; (3) academic aptitude percentile rankings; (4) attendance records; (5) reasons for enrollment in elementary shorthand; and (6) reasons for discontinuing the study of shorthand, as stated by the dropouts. Specific stenographic aptitudes measured by the Turse Shorthand Aptitude Test were manual dexterity, spelling, phonetic association, symbol transcription, word discrimination, dictation, and word sense. In addition to the grade-point scholastic average, subject averages for English, foreign language, general business, bookkeeping, and typewriting were used as specific criteria.

First-year stenographic achievement was measured by a five-minute transcription test given near the end of the elementary course. Second-year stenographic achievement was measured by the final grades received by the students at the end of the advanced shorthand course.

Relationships between selected indices of stenographic potential and subsequent transcription test scores and semester grades were established statistically by the use of correlation coefficients. The study revealed the following coefficients of correlation between the criteria and first-year shorthand transcription test scores: bookkeeping, .57; English, .54; typewriting, .48; foreign language, .47; spelling, .46; total Turse test score, .45; grade-point average, .45; word sense, .41; phonetic association, .40; general business, .38; academic aptitude, .38; dictation, 32; word discrimination, .27; symbol transcription, .22; attendance, .08; and stroking speed, .04. When correlated with second-year shorthand semester grades, the criteria yielded the following coefficients: total Turse test score, .68; foreign language, .63; phonetic association, .59; grade-point average, .55; typewriting, .49; spelling, .48; word sense, .48; dictation, .46; English, .46; general business, .46; symbol transcription, .44; word discrimination, .42; academic aptitude, .41; bookkeeping, .24; and stroking speed, .20.

The findings of the study led to the following conclusions:

1. The Turse Shorthand Aptitude Test total score was the most efficient predictor of stenographic achievement.
2. Grade-point average was a significant factor in predicting the success or failure of prospective stenographic students.
3. Academic aptitude percentile rankings did not predict as efficiently as the more specialized shorthand aptitude test..
4. Attendance records were useless as a factor in group prediction of stenographic achievement.
5. Interest and incentive factors were too subjective for group prognosis.
6. Students who enrolled in stenography with the purpose of preparing for permanent office work were the greatest dropout problem in the elementary shorthand course.
7. More students discontinued the study of stenography between the time of completion of elementary shorthand and the time of enrollment in advanced shorthand than at any other time during the two-year high school stenographic course.
8. Shorthand aptitude test scores, scholastic averages, and academic aptitude percentile rankings were the factors which indicated the greatest usefulness for a predictive team.
9. Success in transcription came sooner to those students who had a better mastery of the language upon which the shorthand system was based and to those who had superior reasoning ability than to those who did not have those skills and knowledges.
10. The Turse Shorthand Aptitude Test predicted achievement in transcription more accurately than it predicted achievement in elementary shorthand.

179 pages. $2.35. Mic 58-4817

A CRITICAL STUDY OF THE EXPERIENCE UNIT IN ELEMENTARY EDUCATION WITH SPECIAL REFERENCE TO THE ELEMENTARY SCHOOLS OF ERIE COUNTY, NEW YORK

(L. C. Card No. Mic 58-709)

Anthony Milanovich, Ph.D.
The Ohio State University, 1952

For half a century our foremost educators have been calling attention to the shortcomings of our schools and making suggestions for eliminating some of the lag in educational practice. However, the lag between theory and practice still exists. Most educators agree that the curriculums and methods of the schools are behind the times. The "slingshot" education of the past few decades is not adequate for the atomic age in which we live. Just as the kerosene lamp has been replaced by the electric light, and the horse and buggy by the automobile, the education of thirty years ago must be replaced by a new education if it is to meet the present needs of American life.

It is the writer's belief that in the light of what we have discovered about the nature, needs, and problems of children; the learning process, the nature of a democratic society, and the best methods of teaching, the Experience Unit is a type of curricular organization which meets the demands of the modern elementary school most effectively.

This study was conducted in Erie County, New York, in which there are approximately 1200 elementary teachers (Grades I-VI) employed in the public schools. The purpose of the study was fourfold: (1) to develop some suitable characteristics of the Experience Unit; (2) to determine the extent to which the Experience Unit is used in the public elementary schools of Eric County, New York; (3) to reveal

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some of the conditions which interfere with the improvement of the elementary schools; and (4) to make recommendations for the most effective use of the Experience Unit in the public elementary schools of Erie County, New York.

There were four major steps in the procedure of this study: (1) formulating and validating the criteria for evaluating the Experience Unit; (2) gathering data from the elementary teachers of Erie County by means of the questionnaire; and (4) interviewing and observing the teaching of a group of the teachers who returned the questionnaire.

In order to develop valid criteria for evaluating the Experience Unit, the writer surveyed the available literature on the subject. Those characteristics of the Experience Unit upon which there seemed to be the greatest agreement among writers were utilized in developing the original criteria. These criteria were then supported in terms of the factors which the writer believes to be basic in a consideration of the most effective curricular organization: the nature of a democratic society, the role of the elementary school, the nature of the elementary school child, and the nature of the learning process. To validate the criteria, they were submitted to a group of thirty-three educators with wide and practical experience in the field of elementary education. After considering the original criteria and the judgment and suggestions of the jury, the final set of criteria, which follows, was evolved.

An effective Experience Unit in the elementary school:

I. Originates in the common needs, interests, and problems of the pupils as they evolve in a social matrix.

II. Stresses and provides for differences in pupil capacities, interests, and talents.

III. Is selected, developed, and directed cooperatively (by pupils, teachers, parents, administrators, etc.). Pupils under the direction of their teachers, play a major role in the selection and development of the unit.

IV. Provides for the selection of materials and activities through teacher-pupil planning as the unit progresses. This does not preclude the possibility of broad pre-planning in terms of resource units or problem areas.

V. Provides for a sequence of learning activities determined by the experiential background, interests, and needs of the pupils.

VI. Provides for the organization of knowledge in terms of the experiential background, needs, and purposes of the pupils.

VII. Utilizes many sources of information and a wide variety of learning activities based upon the direct, first-hand experiences of the pupils. Facts, information, knowledge, skills, and understandings are taught functionally in relation to these activities. This implies that the unit cuts across subject-matter lines, drawing upon whatever subject matter contributes to the solution of problems, the meeting of needs, or the extension of interests.

VIII. Is centered in present-day living. Materials dealing with the past are utilized as they contribute to the solution of present problems.

IX. Stresses the emotional, mental, social, and physical development of each child and the interrelatedness of these four aspects.

X. Provides for the development of the characteristics of a democratic personality (e.g., critical thinking, social sensitivity, cooperation, tolerance, etc.).

XI. Provides for the extensive use of community resources in carrying on pupil activities.

XII. Is comprehensive and extends over a considerable period of time, the length being dependent upon the plans which have been adopted by the group.

XIII. Utilizes a relatively large block of time within the daily schedule, the time span being dependent upon the maturity level of the pupils and the nature and complexity of the problem.

XIV. Provides for continuous, cooperative evaluation of group progress toward established goals, and uses a wide variety of practices and instruments for determining all-round pupil development.

XV. Provides many leads to new units.

On the basis of the above set of criteria, a questionnaire on curricular practices was prepared and sent to the elementary teachers, who were selected at random from the faculty lists supplied by the superintendents of schools in Erie County. A questionnaire was sent to approximately every eighth teacher, or to a total of 156 teachers. Altogether, 132 teachers filled out and returned the questionnaire, a return of 84.6 per cent. The questionnaire served two purposes: (1) to show the ways in which, and the extent to which, the curricular practices of the teachers are consistent with the criteria of the Experience Unit; and (2) to reveal some of the factors which prevent more extensive use of the Experience Unit.

In order to increase the reliability of the questionnaire data, the writer visited and interviewed forty-eight of the 132 teachers who responded to the questionnaire. The writer then responded to the major items on the questionnaire.

Conclusions

1. The Experience Unit, as defined in this study, is not being used in toto by any of the elementary teachers of Erie County, New York.

2. On the whole, the Experience Unit is being implemented to a slight degree in the elementary schools of Erie County. Most of the so-called "units" taught should come under the classification of subject-matter units.

3. The term "unit teaching" is almost meaningless; in most cases it is restricted to a single field of knowledge and refers to a "slice" of subject matter.

4. Besides not being comprehensive enough, units are sometimes too short, and often sufficient time is not devoted to them in the daily program.

5. Rarely do learning activities and units grow out of the common needs, problems, and interests of the pupils. Practically all of them originate in the required subject matter of the textbooks and courses of study.

6. Pupils play a very minor role in the selection of units, and in planning materials, activities, procedures, and outcomes.

7. One unit seldom provides leads to new ones. Specific units are usually prescribed by the textbooks and courses of study. Units are ordinarily repeated year after year and in the same order.

8. Very few of the elementary teachers in Erie County have advanced beyond the stage of correlation in their teaching. In many instances the degree of correlation is limited (e.g., reading and art, spelling and writing).

9. Sequence of learning activities, as well as organization of knowledge, is determined primarily by the textbooks and course-of-study writers. Only occasionally are

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they determined by the experiences, needs, purposes, and interests of the pupils.

10. The sources of information are often limited, as are the activities based upon direct, first-hand experiences. Seldom are information, skills, and understandings taught in relation to the activities.

11. There is some provision for individual differences in rates of learning, but much more attention should be given to differences in the capacities, interests, and talents of pupils.

12. Not enough attention is being given to the methods by which democratic characteristics can best be developed. Many teachers believe that they are developing them effectively even though they employ the most traditional methods of teaching.

13. Teachers select much of the materials and most of the activities in advance of the teaching, leaving very little opportunity for teacher-pupil planning.

14. Beginning with the third grade, the curriculum is usually centered in the past. Only in the first and second grades is it centered in present living.

15. Some consideration is being given to the all-round development of children, but the primary emphasis is upon mental development.

16. Community resources are being utilized very little.

17. The method of evaluation needs to be improved considerably.

18. Most daily schedules are comprised of several short periods, and, as a rule, schedules are followed very closely. There is little cutting across subject-matter lines.

19. There is still much emphasis upon formal recitation, memorization, and mastery of isolated facts and skills in the elementary schools of Erie County.

20. The elementary teachers of Erie County are well prepared, have attended school recently, and have had broad experience in elementary-school teaching.

21. The conditions which seem to prevent the Experience Unit from being implemented to a greater extent are small classrooms, inadequate materials and equipment, rigid courses of study, preparation for required tests, uncoöperative parents, dictatorial administrators, lack of proper college preparation, and lack of desirable in-service education.

Recommendations

A. State-wide Administration and Supervision

1. The teachers colleges of New York State should include courses on unit teaching in the curriculum.

2. The Regents' examinations should be abolished.

3. The State Education Department should provide leadership and assistance in curriculum study, but it must be careful to avoid state-wide prescription of the curriculum.

B. Local Administration and Supervision

1. Every elementary teacher should teach art, music, and physical education to the children in his charge.

2. Curriculum coordinators or elementary consultants should be employed in several of the local school districts.

3. The locally required tests and prescribed courses of study should be abolished.

4. A variety of supplementary reading materials on various topics and at different reading levels should be provided throughout Erie County.

5. Local administrators should take more interest in curriculum improvement.

6. Individual schools should be given more freedom to develop their own programs.

7. Administrators should be more democratic.

C. Individual School Administration and Supervision

1. Principals should devote more time to professional leadership and supervision.

2. There should be more effective in-service education programs carried on in each of the larger elementary schools.

3. There is need for a consistent philosophy of education in many schools, arrived at through the coöperation of all teachers.

4. Teachers' meetings should be improved. Discussion of routine matters should be replaced by the study of teachers' problems and the improvement of children's experiences.

5. Principals should be ever ready to interpret and support the philosophy of the schools.

D. Classroom Practices

1. Learning units should originate in the common needs, interests, and problems of children to a greater extent than at present.

2. Emphasis should shift from uniform achievement and textbook mastery to more consideration of the differences in pupil capacities, interests, and talents.

3. Pupils should play a greater role in the selection, development, and direction of units.

4. Materials and activities should be selected through teacher-pupil planning as needs arise to a greater extent than at present.

5. The experiential background, interests, and needs of the children should play a much greater part in determining the sequence of learning activities.

6. Knowledge should be organized in terms of the experiential background, needs, and purposes of the pupils to a greater extent.

7. There is a need for increasing the sources of information and the number and variety of learning activities. More activities should be based upon direct, first-hand experience. Furthermore, facts, information, knowledge, skills and understandings should be taught in relation to these activities to a greater degree.

8. Units should be centered in present living to a greater extent than they are.

9. Less time should be devoted to mental growth, and more emphasis should be given to social, emotional, and physical development.

10. Greater effort should be made by teachers and administrators to discover the most effective methods for developing the characteristics of the democratic personality.

11. Community resources should be utilized more extensively in carrying on pupil activities. Field trips should be utilized to a greater extent than at present.

12. Units should be more comprehensive and often should extend over a longer period of time.

13. Larger blocks of time should be devoted in the daily schedule to unit teaching.

14. Evaluation should be more continuous, and there should be more pupil participation in it. A greater variety of practices and instruments should be utilized to measure all-round development.

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15. One unit should provide leads to new units more often. 286 pages. $3.70

Abstract published by special arrangement with The Ohio State University.

SITUATIONAL FACTORS AFFECTING CREATIVE WORK BY INDIVIDUALS IN GROUPS: AN EXPLORATORY STUDY TO DEVELOP A CONSISTENT THEORETICAL POSITION AND TO IDENTIFY HYPOTHESES OF THAT POSITION

(L. C. Card No. Mic 58-655)

Chandler Montgomery, Ph.D.
New York University, 1957

The major purpose of the study was to develop systematically organized theory on situational factors affecting creative work by individuals in groups. Subordinate problems, to identify hypotheses of the theoretical position and to apply the position as a whole to selected situations, were undertaken as a first test of the theory's usefulness for research.

Situation was defined as that which is relevant to but outside the act, with primary emphasis on social and physical environment. Group as two or more persons who have come together and set up communication for a common purpose. Creative work as the statement of preferences or choices, based on both intuitive and rational experience with materials in the situation and thereby bringing into existence an organization of these materials which is unique. Material as that which is worked with, including psychological, social, and physical things and relationships.

It was assumed that in the absence of certain pathology all individuals could work creatively in group situations and that they could work more creatively under some conditions than under others.

The significance of the problem lay in the widespread need for a high quality of individual participation in work which is done in groups, is directed toward outcomes hitherto unknown, and is not amenable to solution by logical problem solving alone; and in the need for organized theory concerning what helps or hinders such qualitative work.

A preliminary list of situational factors, projected from personal experience, was checked with a wider range of experience reported in related studies and was analyzed for consistency and universality. The reconstructed list of (affecting) situational factors, modified by accompanying lists of characteristics of (affected) creative work by individuals in groups, was presented as the theoretical position.

Hypotheses were then formulated from the position as a whole and from its situational factors.

In applying the position to individuals in a group situation, instruments were developed and used systematically to answer specific questions. The data showed that creative work was done by individuals in the group, that the situational factors of the position were identifiable as effectively present in some degree, indicated as locations on each of the continua, and that all observed situational factors were included in the position.

Certain theoretical problems were raised by the study. The applicability of individual creative process to work by individuals in groups was explored in terms of psychological-physical possibility, as well as social desirability. A theoretical distinction was drawn between creative work and logical problem solving by individuals in groups. It was found that important situational factors, external to creative action, occurred within as well as outside the individual in creative work in a group.

Evaluative analysis of the theoretical position indicated that, in the degree to which it had been applied, it met requirements of internal consistency, completeness, and systematic potentiality, and that it presented a generalized, explanatory description sufficient to provide understanding required for further study. 173 pages. $2.30

COUNSELOR DOMINANCE: THE DEGREE OF DOMINANCE ATTRIBUTED TO COUNSELORS BY JUDGES AS COMPARED WITH THE COUNSELOR'S CONCEPT OF HIS ROLE

(L. C. Card No. Mic 58-638)

Gladys C. Murphy, Ph.D.
New York University, 1957

Chairman: Professor Robert Hoptock

The Problem

The purpose of this study was to determine whether dominance occurred in one kind of counseling situation and to determine, if it occurred, whether it reflected a conscious control by the counselor or a degree of dominance greater than he assumed he was exerting.

Procedure

Whether or not dominance occurred in the counseling interview was investigated in two ways. Fifteen high school counselors submitted two recorded interviews which they considered typical of their usual interview procedure. Verbatim transcripts of these recorded interviews were examined by three independent judges. Each of the counselor responses was assigned to one of four categories as outlined in the Categories for Analysis of Responses. The same judges also assigned one of the four roles described in the Categories for Analysis of Counselor Roles to each counselor on the basis of an over-all evaluation of the counseling interviews.

Whether or not dominance reflected conscious control by the counselor was investigated by having each counselor select in rank order those roles on the Categories for Analysis of Counselor Roles which he considered most typical of him. These data were compared with the judges' assignment to the same roles.

Results

The statistical data revealed a high degree of agreement among the judges. The number of responses assigned to the two most dominant categories exceeded the number of responses assigned to the two least dominant categories in twenty-two of the thirty interviews.

Eleven of the fifteen counselors assigned themselves as a first choice to a role less dominant than the one assigned to them by judges.

The analysis of the interviews revealed that counselors

maintained control of the interview, either made choices, or influenced the choices of the client. Counselors placed greater emphasis on the use of tests and other data than on the feelings of the client.

Conclusion

Counselors are more dominant than they think they are.

Recommendations

If one assumes that self-direction is a desirable goal for everyone in a democratic society, the degree to which the counselor exerts dominance jeopardizes independent action and discourages self-direction.

Counselors need to evaluate their practices by recording actual interviews, sharing them with a professional colleague, analyzing them with a counselor trainer, or checking them with criteria outlined in the thesis.

The implications of this research are not limited to counselors. Administrators need to evaluate the ways in which they foster dominance by their own educational philosophy, the duties they assign to counselors, and their expectations of the results expected from counseling.

Counselor trainers need to investigate why exposure to desirable counseling attitudes does not produce these attributes. The recommendations for adequate preparation in counseling include: screening of candidates, training in the theories of counseling, training in the analysis of counselor and client responses, training in communication analysis, laboratory practice, and supervised internship.

Certification bureaus in state departments of education should consider the desirability of including these recommendations in their certification requirements for counselors. 169 pages. $2.25

A STUDY OF THE EDUCATIONAL VALUES OF COLLEGE RETAIL WORK EXPERIENCES FOR GRADUATES IN THE FIELD OF RETAILING

(L. C. Card No. Mic 58-969)

Marion A. Niederpruem, Ph.D.
University of Michigan, 1957

This investigation was primarily an exploratory, quantitative study, on the undergraduate and graduate school levels, of work experiences in retailing in relation to their outcomes. These work experiences may or may not have been included in retailing curricula.

The primary objective of the study was to find some relevant facts about the retail work experiences of college students which would lead to significant implications for structuring and improving these work experiences from the educational as well as the retail store points of view. The secondary objective was to test for significant differences between those who had retailing work experience while in college and those who had none.

A list of criteria for work experiences was developed and used as a guide in constructing instruments for carrying out the purposes of this study. The criteria were obtained by: (1) perusing the literature of the philosophy underlying work experiences as a method of learning; (2) analyzing the objectives of field courses (cooperative training programs); (3) interpreting the appraisals of work experiences of a small group of college graduates.

In a group of retail department stores in a Midwest region, 1955 college graduates in junior executive training programs were asked to fill out questionnaires regarding their college background and college retail work experiences. The work supervisors of these graduates were asked to rate them on personal, work, and human relations qualities. As quantitative data were used throughout in the presentation of the findings, these facts and figures were supported with pertinent direct quotations from responses of interviews with personnel executives, graduates, and work supervisors.

This research population was characterized by using statistical measures to describe or summarize the data obtained from the sample. "Descriptive statistics" were used in summarizing the obtained data and "inferential statistics" were used to test the hypothesis and investigate the differences between the subgroups with respect to outcomes of retail work experiences. This sample of graduates comprised four major analysis subgroups: Group I (Retailing courses and work experiences); Group II (Only retailing courses); Group III (Only work experiences); Group IV (Neither retailing courses nor work experiences).

The analysis and interpretation of the data led to the conclusions first in terms of the whole group, then in terms of testing the hypothesis. The results of testing the data led to the acceptance of the hypothesis that the individuals in the sample who had work experiences were significantly different with respect to many attributes in the area of retailing from those who had no work experiences.

The statistical analysis of the research population also shows that the graduates had certain attributes in retailing (concepts, understanding, attitudes, skills, personality qualities) which were related to work experiences and/or retailing courses. There are, however, implications that more attributes and possibly greater development of these attributes were effected by the combination of retailing courses and work experiences. The results may be interpreted to suggest that retailing courses complemented with work experiences provide the most effective preparation for college students entering retailing after graduation.

The main outcomes of the investigation were:

1. Much valuable information about a 1955 college graduate sample regarding their college background and college retail work experiences.
2. A better understanding of the responsibilities of the educator and retailer towards college students interested in retailing.
3. Suggestions, incorporated in the responses, that should motivate and help: (a) retailers in structuring work experiences for college students; (b) educators in planning and supervising retail work experiences, and in relating them to retailing courses.
4. Realization of the need for considerable research specifically in the areas of retail work experiences and retailing collegiate courses and, in general, retailing curricula. 204 pages. $2.65

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ENGINEERING, GENERAL

AN INVESTIGATION OF THE EQUIVALENCE OF DIFFERENT PERCEPTUAL STIMULI IN RATING

(L. C. Card No. Mic 58-550)

Richard Wilson McGuire, Ph.D.
The Ohio State University, 1957

Many contemporary Industrial Engineering techniques are based upon the assumption of the equivalence of observing motion pictures and observing actual operations. One such technique is time study rating. An experiment in which two balanced groups of trained observers were used to rate a series of industrial operations both on site and on film was conducted. The data were collected, organized, and subjected to tests for normality, etc. Several series of analysis of variance tests were run on ratings as well as normal times. These revealed at a very high significance that observing motion pictures was different from observing the actual sequence. The experimental design permitted inferences to be drawn and conclusions to be made concerning items other than perceptual equivalence. Such items as individual differences, observer-operator interactions, etc., are brought out in the discussion of results. 178 pages. $2.35.

ENGINEERING, AERONAUTICAL

AN ANALYSIS OF CERTAIN ERRORS IN ELECTRONIC DIFFERENTIAL ANALYZERS

(L. C. Card No. Mic 58-1393)

Paul Crowther Dow, Jr., Ph.D.
University of Michigan, 1957

The purpose of this investigation is to analyze the errors in electronic differential analyzers which are used to solve systems of ordinary linear differential equations having constant coefficients. The sources of the errors are determined, methods of evaluating them are described, and the effects of the errors on the solutions of problems are studied.

When a mathematical problem is set up on an analog computer or differential analyzer, the computer produces a solution which differs from the solution of the given problem because of the errors in the computer. Stated another way, the computer solves a different problem or equation, referred to as the "machine equation." Thus, in determining the effect of the errors in the computer, one can compare the true solution of the given equation with the solution rendered by the machine, or one can compare the machine equation itself with the given equation. In this study both methods of analysis are used.

The sources of computer errors considered in this investigation include 1) the frequency response characteristics of the operational amplifiers, 2) stray capacitance in the summer and integrator circuits, 3) the absorptive properties of the capacitor dielectric material, 4) capacitor leakage resistance, 5) amplifier unbalance and grid current, and 6) inaccuracy in the values of resistors and capacitors.

It is shown in the analysis that the errors resulting from the amplifier frequency response characteristics, stray capacitance, and capacitor leakage resistance can be represented by changes in the constant coefficients of the differential equation and by changes in the input or forcing functions. The errors resulting from the capacitor dielectric absorption produce changes in the location of the roots of the characteristic equation in addition to changes in the effective integrator initial conditions. These changes in initial conditions, as well as the effect of amplifier unbalance and grid current, can be represented by additional inputs or forcing functions to the given equation. Mathematical expressions are developed which permit one to determine the changes in the coefficients, roots, and forcing functions of the given equation if certain physical properties of the amplifiers, resistors, and capacitors are known. Except for the capacitor dielectric absorption, these properties can be obtained by well-known measurement techniques. The behavior of the capacitor dielectric material is studied in some detail, and experimental methods are described which permit determination of the parameters needed in the error analysis.

The theory is used to evaluate the error in the solution of the equation for simple harmonic motion on two typical differential analyzers, the Reeves Electronic Analogue Computer (REAC) and the Sterling Electronic Differential Analyzer. The error is also determined experimentally and shows excellent agreement with the theory. In this particular example, it is seen that in the frequency spectrum of about 0.1 to 10 rad/sec the error due to dielectric absorption is predominant. The application of the theory to other typical computer problems is illustrated.

The methods of this investigation permit one to determine 1) the effect on the problem being solved of certain non-ideal characteristics of the differential analyzer, and 2) the characteristics which the computer must possess if it is to solve ordinary linear differential equations with a prescribed degree of accuracy. 158 pages. $2.10.

A THEORETICAL AND EXPERIMENTAL INVESTIGATION OF LAMINAR FLAME PROPAGATION

(L. C. Card No. Mic 58-962)

Hans Ralph Menkes, Ph.D.
University of Michigan, 1957

The purpose of this dissertation is to investigate the applicability of constant-flame-speed models to the study

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of laminar flame propagation. With the flame speed fixed at a constant value a considerable simplification in the analytical treatment is possible.

In the theoretical part of this work two simple flame configurations are examined: a flame constrained by two parallel walls (two-dimensional channel) and a free flame. The flow field induced by the flame in the channel is divided into two domains which are separated by the flame front. The flow in the unburnt portion of the gas was represented by the flow field induced by a sink placed at a suitably selected point in the channel. A differential equation for the flame shape with the flame speed as a parameter was derived and solved by a graphical-numerical method (Peano's Method). The existence and uniqueness of the solution was investigated in detail. Sufficient information is provided to solve for the flow field in the burnt portion of the gas by a relaxation procedure. It is shown that the prescribed values of the velocity vector along the flame front usually overdetermine the solution of the flow field in the burnt portion of the gas.

The free flame was represented by a source sheet. The representation of plane flames, V-flames, and flames with radial symmetry by a finite source sheet are examined. An integral equation is presented that relates the flame shape to the prescribed value of the flame speed.

For the experimental investigation a two-dimensional Bunsen-burner-type flame was chosen. Maps of the flow field were obtained by a flow-visualization technique utilizing titanium dioxide powder as tracers. The effect of the particle inertia which manifests itself in a deviation of the observed flow lines from the true ones was calculated.

The flame velocity was found to be sensibly constant over the major portion of the flame front. It is demonstrated that the strong variation of the normal velocity in the tip region is necessary to produce the flow field customarily observed in Bunsen-burner flames. The measured tangential velocity variation as well as the variation of the total velocity obtained by following a specific particle along a streamline indicated that a considerable expansion takes place within the reaction zone. The latter observation implies that the "thin" flame approximation is open to some criticism. The flame-generated vorticity was seen to depend primarily on the variation of the flame speed. The contribution of the tangential velocity was found to be negligible.

Summarizing, one can say that constant-flame-speed models give a qualitative indication of the flame-induced flow field of a real flame. 95 pages. $2.00.

ENGINEERING, CHEMICAL

EFFECT OF INITIAL VELOCITY DISTRIBUTION ON HEAT TRANSFER IN SMOOTH TUBES

(L. C. Card No. Mic 58-873)

Peter Herman Abbrecht, Ph.D.
University of Michigan, 1957

The Purpose of this study is to investigate the effect of initial velocity distribution on heat transfer to air flowing in a smooth tube. It is known that the geometric form of the inlet to a heat exchanger tube strongly influences the heat transfer coefficient in the inlet region. This effect is primarily due to the initial velocity distribution produced by the inlet. By measuring temperature and velocity profiles, and point heat transfer rates in the inlet region, it is hoped to gain a better understanding of the mechanism by which these effects occur.

Measurements were made for heat transfer to air flowing in a 1.52 inch inside diameter tube with the following geometric entrances: 1) a long tube which gave essentially fully developed turbulent flow, and 2) a bellmouth entrance which gave an initially flat velocity profile. Measurements were taken at distances of .453, 1.13, 1.75, 4.12, and 9.97 tube diameters downstream from the start of heating at Reynolds numbers of 15,000 and 65,000. Pressure drop measurements were also made in this region.

Longitudinal and radial temperature gradients, radial heat fluxes, and eddy diffusivities for momentum and heat transfer were computed from the measurements.

The ratio of eddy diffusivity for heat transfer to that for momentum transfer, α, was found not to be a function of length in the thermal inlet with fully developed flow. Over most of the tube cross section the ratio was about 1.5. The ratio α was a function of length for the bellmouth inlet.

The radial heat flux was found to be essentially constant in the laminar and buffer zones and to vary linearly in the turbulent zone.

Pressure drop due to acceleration effects was found to be appreciable compared to wall friction losses in the bellmouth inlet.

It is concluded that theoretical analyses which postulate the same distribution of eddy conductivity in developing thermal boundary layers as for fully developed ones are valid for the case of fully developed hydrodynamic boundary layers in the thermal entrance region, but may be subject to large error when the hydrodynamic and thermal boundary layers develop simultaneously.

148 pages. $2.00.

THE CONDENSATION OF SUPERHEATED FREON-114 AND STEAM VAPORS OUTSIDE A HORIZONTAL TUBE

(L. C. Card No. Mic 58-876)

Garen Balekjian, Ph.D.
University of Michigan, 1957

A review of the literature on the condensation of superheated vapors indicated meager information for superheated vapors condensing on the outside of a horizontal tube and a general lack of understanding of the behavior of superheated vapors under widely different conditions.

The condensation of superheated Freon-114 and steam was investigated on the outside of a plain 0.750-inch-diameter horizontal copper tube housed in a 6-inch-diameter shell. Experimental data with measured wall temperatures were obtained for superheated Freon-114 condensing at pressures of 43.7 and 77.0 lb per sq in. absolute and for superheated steam condensing at 9.16, 23.35, 23.87, and 44.09 lb per sq in. absolute.

It was observed that superheat in the vapor caused a

lowering of the tube surface temperature. Studies indicated that this was related to a lowering of the condensate surface temperature as well. A general lowering of the heat flux as much as 23.4 per cent below that of the saturated vapor was obtained with increasing superheat. This lowering of the heat flux was explained and correlated with the condensing load. The overall performance obtained with the condensation of superheated vapors under various conditions of pressures, superheats, and tube surface temperatures was explained by the relative importance of interphase, and intraphase processes of mass and energy transfer.

The general theory of interphase mass and energy transfer was applied to explain the condensation of superheated vapors by a mechanism of mass and heat transfer through the vapor-liquid interface. The behavior of superheated vapors under widely different conditions was predicted by interphase transfer theory. The theoretical equation was modified and used to correlate satisfactorily the experimental condensing load and the calculated temperature and pressure conditions at the interface with the degree of superheat. The applicability of the correlating equation to predict condensing loads and interfacial film conditions for fluids other than Freon-114 and steam was discussed.

The calculated condensate surface temperatures were used to determine the temperature drop through the interfacial film. Interfacial film coefficients were calculated and correlated with the temperature drop through the interfacial film and the temperature and pressure conditions at the vapor-liquid interface. The variation of the interfacial film coefficient and heat flux in the region close to the "dry point" was obtained by extrapolation of the calculated interfacial film coefficients. The prediction of the "dry point" for a given application was presented and illustrated in a method correlating the interfacial film coefficient with the free convection and radiation film coefficients at the "dry point."

Condensate film coefficients calculated by the conventional method used for the design of superheated vapor condensers were evaluated by comparison with the experimental results. The limitations of this procedure were pointed out. The equation correlating the results from the filmwise condensation of superheated Freon-114 and steam was used in the outline and illustration of a basic procedure for the design of condensers involving the filmwise condensation of superheated vapors outside horizontal tubes. The applicability of this method for peculiar conditions of low pressures, high superheats, and high condensate surface temperatures was discussed.

174 pages. $2.30.

ADSORPTION AND THE CATALYTIC OXIDATION OF ETHYLENE

(L. C. Card No. Mic 58-1071)

Donald Weston Bolme, Ph.D.
University of Washington, 1957

The role of adsorption in the oxidation of ethylene in the presence of a silver catalyst has been studied using a differential reactor.

Oxidation results obtained at 200° C and atmospheric pressure have been compared with known adsorption data of the reactants and products upon silver and silver oxide. It was found that no defensible correlation existed between adsorption as it affects kinetics and adsorption as measured directly on either silver or silver oxide. The data were also interpreted as to probable catalytic mechanism and probable catalytic site constitution. The catalytic mechanism was shown to be surface reaction rate controlling in the production of both ethylene oxide and carbon dioxide.

One site mechanisms were eliminated for the production of ethylene oxide. Of the two site mechanisms not eliminated the one which best fit the available data was the impact of a gaseous oxygen molecule on two adsorbed ethylene molecules. The catalytic mechanism for the production of carbon dioxide is postulated to be the impact of a gaseous molecule of oxygen upon a single adsorbed ethylene molecule. A mechanism is proposed to explain the long range variation of catalyst activity with reactant and product concentrations.

The possible makeup of the catalytic site is considered and indirect evidence for the location of the catalytic site at the metal-metal oxide interface is given.

The catalyst is activated by pretreatment with hydrogen followed by ethylene oxide. This and previous methods of activation by pretreatment are discussed and interpreted in the light of the mechanism which was proposed to explain the long range dependence of the catalytic activity upon reactant and product concentrations.

Data collected at 220° C are also presented and briefly discussed. The possibility of two different types of catalytic sites is discussed. 135 pages. $2.00.

THE DEVITRIFICATION OF HIGH-TEMPERATURE GLASS

(Publication No. 24,370)

Sherman Daniel Brown, Ph.D.
University of Utah, 1957

Chairman: Dr. S. S, Kistler

The works of previous investigators in devitrification and related areas of physics and chemistry were reviewed. It was found that none of the existing equations for the temperature dependence of the growth rate in the devitrification process were able to fit all the available data. Further, seeming contradictions were found to exist among the publications of various authors on the effects of composition on the devitrification rate. It was also concluded that formulae for the homogeneous nucleation rate which are found in the literature have one theoretical flaw: viz., they represent not the number of growth centers developed per unit space per unit time, but the gross growth rate of that number of critical nuclei which is thermodynamically stable under the conditions imposed upon the system.

Equations for the overall devitrification rate, the growth rate, and the homogeneous nucleation rate were derived. The equation for the growth rate was compared with the experimental data of several authors, and it was found to provide an excellent fit in all cases.

Homogeneous high-silica glasses of the system Al_2O_3-SiO_2 were prepared by fusing under vacuum sintered mixtures of alumina and silica. The sintered mixtures of alumina and silica were prepared by precipitating $Al(C_9H_6ON)_3$ onto a finely divided (200 A particle diameter) form of relatively pure (approx. 99.968% SiO_2) silica, drying the resulting paste at 270°C for 12 hours and then at 850°C for 18 hours, and sintering the dried mixture of alumina and silica for 5 hours at temperatures between 1400° C and 1500°C. This procedure helped circumvent contamination of the sample which may have resulted were conventional methods of preparation employed. The glasses were characterized by chemical, X-ray, and infrared analyses.

The devitrification growth rate (crystal phase cristobalite) and the viscosity were determined as functions of temperature (1200°C to 1450°C) for the following values of $Al^{+3}/100\ Si^{+4}$: 10^{-7}, 0.118, 0.225, 0.634, and 1.097. The results indicate that the growth rate of cristobalite in the glasses studied is controlled by the rate at which crystal forming species which are adsorbed on the surface of the crystalline phase can reorient into a satisfactory precrystallization position (i.e., the entropy of activation for the surface reaction is a sizable negative number).

431 pages. $5.50. Mic 58-4818

FROTH STRATIFICATION AND LIQUID MIXING IN A BUBBLE TRAY COLUMN

(L. C. Card No. Mic 58-896)

Ronald David George Crozier, Ph.D.
University of Michigan, 1957

The hydraulic characteristics of both bubble-cap and sieve trays were studied in a 13- by 7.5-inch rectangular column. The bubble-cap plate had nine 1-1/2-inch bubble-caps on a 2-1/2-inch square pitch. Each cap had eighteen 1/8-inch by 3/4-inch slots, which extended to the tray floor. The sieve tray had 13 by 13 rows of 11/64-inch drilled holes on 7/16-inch square spacing. The air-water system was used for all runs.

The purpose of the investigation was to determine the effect of operating variables on the local density distribution in the froth and the degree of liquid mixing. The range of operating variables studied were liquid rates from 1 to 4.30 gal/min-inch of weir, gas superficial velocities from 0.6 to 4.5 ft/sec, and weir heights of 1, 2, 3, and 3-1/2 inches.

The fractional extinction of a light beam transmitted by the froth was found to be a function of local froth density. The local froth density on a tray was found to stratify into three layers. High speed photographs of the froth showed the three layers to be due to: (a) sheets of gas around caps, giving a local density near the pure liquid density; (b) break-up of the gas sheets into bubbles above the caps resulting in a variable density layer; and (c) coagulation of the bubbles formed into a constant density layer. The constant density layer was found to occur only if the clear liquid height in the active area of the tray was higher than the total cap height. The sieve tray always showed a constant froth layer. The specific interfacial area (ft^2/ft^3 of froth) available for mass transfer was found proportional to the froth layer density rather than the average bulk froth density, explaining discrepancies found in mass transfer rates determined by different investigators operating columns with clear liquid heights above and below cap height.

The relation between point (E_{OG}) and plate (E_{MV}) Murphree efficiencies, including the effect of mixing, was found to be:

$$E_{MV} = \left(\frac{1+\gamma}{\lambda}\right)\left(\exp\frac{E_{OG}\lambda}{1+\gamma} - 1\right) \qquad (23)$$

where $\lambda = mV/L$; m is the slope of equilibrium line; V is the gas rate; and L is the liquid rate.

The degree of liquid mixing was measured in the column using a dye tracer and colorimetric analysis. The relative mixing on the tray was found to increase slightly with increasing gas rate and decreasing liquid rate, but varied little from $\gamma = 1$ for the operating conditions studied, and γ, the mixing parameter, is defined in terms of unsteady state tracer decay as follows:

$$\mu(\theta) = Co\ \exp\left(-\frac{\gamma L \theta}{A_c}\right)$$

where $\mu(\theta)$ = tracer concentration at time θ
Co = constant
θ = elapsed time, secs.
A_c = clear liquid cross section, ft^2

175 pages. $2.30.

HEAT TRANSFER TO LIQUID DROPS

(L. C. Card No. Mic 58-906)

Eugene Robert Elzinga, Jr., Ph.D.
University of Michigan, 1957

This thesis is an experimental study of the heat transfer rates to a single stream of drops rising or falling countercurrent to a second immiscible liquid phase.

The variables studied were drop diameter, drop frequency, and a range of the physical properties of both liquid phases. Drop diameters ranged from 0.25 centimeters to one centimeter and the frequency was varied from 0.5 drops per second to 5 drops per second. The physical properties studied most extensively were the viscosities of the two phases and the interfacial tension. The dispersed-phase viscosity varied from 0.5 to 10.0 centipoises and that for the continuous phase varied from 0.5 to 7.0 centipoises. The interfacial tension was varied from 8 to 50 dynes per centimeter.

Experimental data was taken in a manner such that the end effects could be eliminated and it was found that a graph of the logarithm of the difference between the continuous-phase temperature and the drop temperature versus drop residence time was a straight line, except near zero time. Three drop models were adopted to explain the transfer of heat inside the drop, and these were used in conjunction with the experimental data to determine the heat transfer coefficients outside the drops.

For those cases in which the drops were not observed

to oscillate, the continuous-phase heat transfer coefficients were correlated by the following equation.

$$\frac{hD}{k} = 5.52\left[\frac{\mu + \mu_d}{2\mu + 3\mu_d}\right]^{3.47}\left[\frac{D\gamma\rho}{\mu^2}\right]^{0.056}\left[\frac{C_pDv\rho}{k}\right]^{0.5}$$

In this relation:

h - is the heat transfer coefficient
D - is the equivalent spherical diameter of the drop
k - is the thermal conductivity of the continuous phase
μ - is the viscosity of the continuous phase
μ_d - is the drop viscosity
γ - is the interfacial tension
ρ - is the continuous phase density
C_p - is the specific heat of the continuous phase
v - is the drop velocity

The heat transfer coefficient is based upon the actual drop area and the difference between the continuous-phase temperature and the temperature at the drop surface. This equation correlates the data for non-oscillating drops in systems where the ratio of drop viscosity to continuous-phase viscosity is equal to or less than one. However, it predicts heat transfer coefficients which are too low for cases where this ratio is greater than one. In these cases, an existing correlation for heat transfer to solid spheres was found to give a better estimate of the heat transfer coefficient. For oscillating drops, the heat transfer coefficients are, in general, much higher than those predicted by the above equation.

Evaluation of experimental results for one liquid-liquid system, with and without the presence of a surface-active material, indicated the manner in which this material affects the heat transfer rates. 154 pages. $2.05.

SHOCK INDUCED CHEMICAL REACTIONS

(L. C. Card No. Mic 58-1405)

Martin Edwin Gluckstein, Ph.D.
University of Michigan, 1957

The purpose of this research was to investigate the utility of the shock tube as a chemical reactor and to determine the feasibility of using shock tube techniques in the study of the kinetic and equilibrium behavior of gaseous chemical reactions.

Significant variables to be examined were determined by extension of the hydrodynamic equations governing the flow in a shock tube to include the effects of changes in the chemical state of the gas. It is shown from this development that the shock velocity and the initial state of the gas may be employed to define operationally the final state of the gas.

For experimental purposes a high pressure shock tube one-half inch square with a four foot long test section was constructed. Special features of this device included an auxiliary chamber to quench the reaction mass and a variable volume reservoir capable of operation at pressures in excess of 10,000 pounds per square inch. This permitted high driver-to-test section pressure ratios to be attained conveniently. The analytical and practical procedures used in the design of the shock tube are presented in detail.

The chemical system examined most extensively in this work was the hydrogen-deuterium system in which the isotope exchange reaction

$$H_2 + D_2 = 2HD$$

was studied in the temperature range from 1,000° to 6,000° Kelvin. These values of temperature were determined operationally from measured values of shock velocity and application of the hydrodynamic conservation laws governing shock flows and the equation of state for a perfect gas. This reaction was shown to proceed to equilibrium in less than 10^{-3} seconds at the extreme temperature. Under less severe conditions the reaction did not equilibrate during the residence time in the reactor and under these conditions it was possible to obtain average rate data. These data appear self consistent and in agreement with the behavior of the system under more usual laboratory circumstances.

Some preliminary studies with the systems CO-H_2 and H_2-N_2 were inconclusive.

It may be concluded from this study that the shock tube may be used for the study of gaseous reactions under conditions which are ordinarily unattainable in the laboratory and to examine the rates of these reactions. It is further concluded that reactions requiring extensive dissociation as a primary process may be shock induced readily and the reaction processes studied in the shock tube.

129 pages. $2.00.

INVESTIGATION OF THE EFFECTS OF ADDITIONS OF ZIRCONIUM CARBIDE AND VANADIUM CARBIDE ON THE PROPERTIES OF TITANIUM CARBIDE BASE CERMETS

(Publication No. 25,451)

Howard Edwin Konrad, Ph.D.
The Ohio State University, 1951

On the basis of the hypothesis advanced by Greenhouse[1] to account for the oxidation resistance of Kennametal's mixed carbide (Ti, Ta, Cb) C bonded with cobalt, or nickel, the decision was reached to investigate the ternary system TiC-ZrC-VC. This system was studied from the standpoint of both oxidation resistance and strengths at elevated temperatures. Both zirconium carbide and vanadium carbide were reported to form a complete series of solid solutions with titanium carbide.[2]

According to the hypothesis set forth by Greenhouse, the rate of oxygen diffusion inward through the oxide layer is proportional to the number of vacant O^{-2} sites. In the case of the mixed carbides (Ti, Ta, Cb) C + Ni and (Ti, Ta, Cb) C + Co, the pentavalent Ta and Cb ions act to decrease the number of vacant O^{-2} sites in the oxide and thereby retard the diffusion of oxygen through the oxide to the body. Since vanadium can also exist in the pentavalent state, it was postulated that additions of vanadium carbide to titanium carbide base cermets should also result in improvement in the oxidation resistance. Since zirconium carbide possesses good strength properties, it was thought that the strength of titanium carbide base cermets might be improved by additions of this material.

Ternary mixtures of the carbides were made, 60 per cent by weight of titanium carbide being the least amount

of this material present in any composition. To these mixed carbides, 20 per cent by weight of cobalt or nickel was added as the binder metal. Specimens were fabricated from these mixtures by first pressing the samples mechanically and then re-pressing them hydrostatically. A helium atmosphere or a vacuum was employed in sintering these specimens. It was found that vacuum sintering produced the better compacts.

The solubility relationships between titanium carbide-zirconium carbide and titanium carbide-vanadium carbide were studied. At temperatures as low as 2600° F. (1427° C.) a homogeneous solid solution was formed between titanium carbide and vanadium carbide. In the case of titanium carbide-zirconium carbide combinations, however, only partial solubility was obtained, regardless of the sintering temperature employed. The slow cooling of these mixtures was thought to be responsible for the presence of two carbide phases. The per cent difference in size between titanium atoms and zirconium atoms is sufficiently large that upon slow cooling the carbides would tend to separate. Since a homogeneous carbide phase could not be produced between titanium carbide-zirconium carbide combinations under the sintering techniques used in this investigation, it was assumed that complete solid solution of ternary mixtures of titanium carbide, zirconium carbide, and vanadium carbide would not result. However, even though a homogeneous carbide phase could not be attained, it was possible to produce compacts having less than 2.0 per cent apparent porosity by using vacuum sintering techniques.

When zirconium carbide and/or vanadium carbide was added to titanium carbide base cermets, the oxidation resistance of the body was decreased. Vanadium carbide additions decreased the resistance to oxidation more markedly than zirconium carbide additions. The formation of V_2O_5 in the vanadium carbide bearing mixtures was the cause of the increased oxidation in these bodies. This compound is known to cause accelerated oxidation.[3]

X-ray studies were done on the oxides formed on the bodies (95 per cent TiC, 5 per cent ZrC) + 20 per cent Ni and (95 per cent TiC, 5 per cent VC) + 20 per cent Ni. The titanium carbide-zirconium carbide base cermet oxide contained TiO_2, the metal oxide, and another phase which could not be identified. The unit cell size of the TiO_2 was determined. The A_0 dimension was found to be unaltered, but the C_0 dimension was changed. Therefore, it was assumed that a small amount of ZrO_2 was in solid solution with TiO_2. This solid solution formation, however, did not improve the oxidation resistance of the specimens.

The oxide layer of the titanium carbide-vanadium carbide base cermet contained TiO_2, nickel metal, and another phase which was thought to be a complex nickel bearing oxide. Determination of the TiO_2 unit cell size in this case showed it to be unchanged. Thus, the possibility of the V^{+5} ion being present in the rutile to retard the oxidation rate was eliminated. Since the vanadium was not present in the TiO_2 lattice, it could not be definitely ascertained whether or not the hypothesis developed by Greenhouse is valid. However, the results obtained with the titanium carbide - vanadium carbide combinations indicate that the binder metal present plays a significant role in the development of an impervious oxide layer.

Additions of only 5 per cent by weight of zirconium carbide or vanadium carbide to titanium carbide base cermets were found to decrease both the room temperature and high temperature strengths of the body.

120 pages. $2.00. Mic 58-4819

1. Greenhouse, H. M. "Study of the Oxidation Mechanism in Carbide Base Cermets," Bi-monthly Report No. 2, U. S. A. F. Contract No. 35(038)-16911, The Ohio State Research Foundation, The Ohio State University, May, 1951.

2. Norton, J. T., and Mowry, A. L. "Solubility Relationships of the Refractory Monocarbides," J. Metals (Feb., 1949), pp. 133-36.

3. Des Brasunas, A., and Grant, N. J. "Accelerated Oxidation of Metals at High Temperatures," Quarterly Report, Vol. 2, No. 1, Department of Metallurgy, Massachusetts Institute of Technology, Jan. 1 - Mar. 31, 1951.

Abstract published by special arrangement with The Ohio State University.

THE ROLE OF THE PLASTIC AND THE NONPLASTIC IN RAMMED CLAY BODIES

(Publication No. 25,464)

Karl Emil Krill, Ph.D.
The Ohio State University, 1951

An investigation was made to discover how clay and grog mixes of various plastic:nonplastic ratios and of various nonplastic grain size distributions behave under compaction by ramming, together with the reasons for their behavior and resultant properties. A single structural clay, made up from 70 per cent shale and 30 per cent fire clay, was used. The grog employed in combination with this clay was obtained by grinding culled vitrified clay pipe originally formed from the same clay mix. Eighteen body compositions were investigated. Of these compositions, six lie along edges, nine lie within faces, and three lie in the interior of a single compositional tetrahedron. Compositions varied from 40 per cent clay, 60 per cent grog, to 70 per cent clay, 30 per cent grog. In one series of compositions, the grog ranged from -8 mesh to -48 mesh in fineness of grind. In a second series of compositions, the grog was blended from two dissimilar grain size distributions. Mixes in this series ranged from 100 per cent of the coarse (-8, +20 mesh) with none of the fine (-48 mesh) to 100 per cent of the fine with none of the coarse.

The optimum water content for each mix, to bring it to maximum density when compacted by ramming, was determined by the Proctor soil compaction test. Optimum water contents, as a percentage of batch dry weight, were 9-10 per cent for all mixes. Bar specimens 3 inches by 4 inches by 60 inches were pneumatically rammed into a steel mold by tamping a succession of loose fills of the prepared composition into a compact mass. These bar specimens were cut into 1-foot lengths. Cylindrical specimens were hand rammed from each mix, by using a modified Proctor soil compaction test method. All body compositions were fired at the same rate, to the same final temperature and cone. After being fired, the bar specimens were broken in transverse loading, and the cylinders

were crushed in compression. Body structures were examined macroscopically and microscopically, with particular emphasis on presence of voids, manner of union of the particles, lack of bonding between successive fills, and evidence of internal shear fractures.

From the results obtained in the investigation, certain relationships between the composition of a ramming mix and the physical properties of the product are apparent. An increase in the clay content of a mix increases its transverse strength and drying and firing shrinkages, while decreasing its absorption. An increase in the fineness of the grog incorporated in a mix increases its transverse strength and drying and firing shrinkages, while decreasing its absorption. Among the mixes incorporating grog blended from two different grain size distributions, the most satisfactory area for good strength, low shrinkage, and low absorption centers around a body of one-half clay and one-half grog, with about one-third of the grog of the coarse size. The coarser grog particles serve two important functions in the ramming mix: they enable the loose fill being tamped to "bite" into the previously rammed surface to effect a bond; and they increase the internal friction of the mix, minimizing its tendency to flow laterally out from under the tamping butt. Voids from entrapped air were present in the bodies rammed from all mixes. These voids were usually lenticular, the small dimension of the lens paralleling the direction of the tamping force. Low correlation was found between transverse strength and compressive strength.

Future work in this general area might profitably be directed toward determining the optimum grog particle shape (angular versus rounded) and investigating the benefits to be gained from de-airing.

121 pages. $2.00. Mic 58-4820

Abstract published by special arrangement with The Ohio State University.

A STUDY OF THE RATE OF THERMAL RADIATION THROUGH POROUS INSULATING MATERIALS

(L. C. Card No. Mic 58-1423)

Bert Kenneth Larkin, Ph.D.
University of Michigan, 1957

An experimental and theoretical investigation was made of radiant transfer through porous insulations. Transmission measurements were made under isothermal conditions. These transmission data were then utilized to characterize the radiant transfer through insulations under non-isothermal conditions.

As an approximation, the radiation process was described by two ordinary differential equations containing only two parameters. Complete description of the heat transfer process requires one other equation, the equation of continuity of energy. Because the two equations describing the radiant fluxes were non-linear, an approximate solution of this set of equations was necessary.

Evaluation of the radiant heat transfer rate from the approximate solution requires numerical values for the two parameters. These parameters are the scattering cross section and the absorption cross section of a unit volume of insulation. These parameters were determined experimentally and were also estimated from electromagnetic theory.

The experimental data consisted of a set of transmission measurements for black body radiation through varying thicknesses of an insulation. From these transmission measurements it is possible to calculate the scattering and absorbing parameters.

The radiation properties of 11 different insulations were investigated. Four of these insulations are manufactured commercially; two of these were Fiberglas, one was Foamglas and one was Styrofoam 22. The other insulations, which were utilized in an attempt to demonstrate the effect of fiber size on the radiation parameters, were made of closely sized glass fibers ranging from 0.17 to 35 microns in diameter. Bulk densities ranged from 0.5 to 5 lbs/ cu ft. The temperature of the black body source was varied over a range from 200° to 800° F.

The scattering and absorption cross sections were correlated as functions of temperature, bulk density, and fiber size. As predicted from theory these cross sections were found to go through a maximum radiant transfer, for diameters ranging from 2 to 5 microns. These values of the parameters can be used to compute the contribution of radiant transfer to the total heat transfer through porous insulations with an uncertainty of about 10 percent. Radiation contributes 3 to 10 percent of the heat transfer through the insulations tested at room temperature. At higher temperatures, radiation can account for 20 to 30 percent of the heat transfer. Calculations show that the emissivity of the bounding surfaces greatly influences the radiant transfer through the insulation.

Expressions for the scattering properties of cylinders were derived from electromagnetic theory and illustrative calculations were made for the scattering parameters utilized in the theoretical correlations. In the absence of data on the optical properties of the insulation materials in the infrared range, quantitative comparison of the theoretical and experimental results was impossible. However qualitative agreement was demonstrated and in particular with respect to the optimum fiber size.

183 pages. $2.40.

CONTINUOUS THROUGHPUT RECTIFICATION OF ORGANIC LIQUID MIXTURES WITH VERTICAL, COUNTERCURRENT THERMAL DIFFUSION COLUMNS

(L. C. Card No. Mic 58-811)

David Robinson Longmire, Ph.D.
The University of Wisconsin, 1958

Supervisor: Professor Robert Byron Bird

This study was undertaken with two primary objectives. The first was to relate the degree of rectification in continuous throughput operation of thermal diffusion columns to thermal diffusion coefficients determined in thermal diffusion cell experiments for binary liquid systems of organic compounds. The second purpose was to obtain quantitative information on continuous throughput operation with ternary organic liquid systems in order that general conclusions might be arrived at for such systems.

The experiments were carried out with cylindrical thermal diffusion columns in which the separation chambers were sufficiently narrow so that curvature effects might be ignored. Operating conditions were essentially at atmospheric pressure. Both continuous throughput and closed column experiments were conducted for the two binary systems n-heptane - benzene and benzene - carbon tetrachloride as well as the ternary mixture n-heptane - methylcyclohexane - toluene.

For binary systems the results were correlated on the basis of dimensionless combinations which result when the unintegrated conservation equations of fluid mechanics are placed in dimensionless form. If $\bar{\omega}$ signifies the mass fraction of that component enriched toward the top of the apparatus; D and B the top and bottom product rates; F the feed rate; and cc closed column operation, the ratio of continuous throughput separation to closed column separation was found to be a function of

$$[\omega_F(1 - \omega_F)]^{-1.8} N_{Re}/(N_{Gr} N_\alpha N_{\Delta T})$$

in which N_α is identical to the conventional thermal diffusion factor α. The quantity $N_{\Delta T}$ is the dimensionless temperature difference defined as $\Delta T/T_{av}$, T_{av} being the arithmetic mean temperature of the hot and cold walls. The number $N_{a/L}$ is the ratio of distance between the hot and cold walls to column length. For closed column operation the difference between top and bottom mass fraction, $(\bar{\omega}_D - \bar{\omega}_B)_{cc}$, was a function of

$$[\omega_F(1 - \omega_F)]^{1.3} (N_\alpha N_{\Delta T})/(N_{Gr} N_{Sc} N_{a/L})$$

The combinations of dimensionless groups are identical to the quantities F/H and HL/K_c respectively except for the factors 6! and 504 in the latter quantities which arise from approximate solutions to the equations of change. For both continuous throughput and closed column operation, actual rectification was about 100 per cent greater than that predicted by the theoretical relations of Furry, Clark Jones, and Onsager except for the dilute solution separations, which were smaller than those calculated from the theory.

Results with the ternary mixture showed smaller rectification with higher throughputs. Wider wall spacing gave better separation between top and bottom fractions for all three components at the higher throughputs, a characteristic of continuous throughput operation with binary systems. The addition of n-heptane to mixtures of methylcyclohexane and toluene improved the tendency for methylcyclohexane and toluene to separate.

It is possible to describe quantitatively both closed and open thermal diffusion column operation in terms of the thermal diffusion coefficients arrived at in steady state thermal diffusion cell experiments. The combinations of dimensionless groups upon which operation depends can be deduced by use of the unintegrated dimensionless equations of change. For the ternary mixture n-heptane - methylcyclohexane - toluene, rectification decreases at higher throughputs. At higher throughputs rectification is better for a wall spacing of 0.079 centimeters than a wall spacing of 0.043 centimeters. 292 pages. $3.75.

NATURAL CONVECTION INSIDE A HORIZONTAL CYLINDER

(L. C. Card No. Mic 58-960)

William Rogers Martini, Ph.D.
University of Michigan, 1957

Natural convection heat transfer inside a horizontal cylinder was studied from an experimental and from a mathematical viewpoint. The velocity and temperature fields were measured at the center of a horizontal cylinder 4″ in diameter and 36″ long. The cylinder was filled with air at atmospheric pressure. The right half wall of the cylinder was heated and the left half wall was cooled. Wall temperature differences ranged from 2° to 200° C. The temperature field was measured by thermocouple traverses. The velocity field was measured by multiple exposure pictures of fine dust particles floating in the air space.

It was found that all heat transferred by convection was accomplished by a rapidly rotating annular boundary layer. Inside this 1/2″ thick boundary layer the central core remained essentially stationary due to a vertical temperature gradient produced by heat transfer from the inside edge of the boundary layer. As the wall temperature difference increased above 20° C, the overall rate of gas circulation decreased. The average Nusselt number based upon the cylinder diameter, the wall temperature difference, and the average temperature gradient over either the hot or the cold surface was found to be constant at 7. The local Nusselt number was observed to be a definite function of the wall temperature difference at some points and essentially not a function of wall temperature difference at others.

In addition to the above experimental investigation, an attempt was made to compute from the experimental boundary conditions the velocity and temperature fields for comparison with the experimental data. Five partial differential equations in five unknowns were developed which involve the conservation of heat, mass and momentum as well as the equation of state. These equations were reduced to three in number by assuming a perfect gas and essentially constant pressure. These three equations in three unknowns were converted to explicit difference equations for a cylindrical grid with variable radial mesh spacing (80 internal points in the grid). The calculation was done on the IBM-650 Magnetic Drum Computer.

It was found that the above calculation procedure could be made stable only by abridging it so as to make it linear. For instance by specifying the velocity field obtained from the experiment as constants in the numerical solution, one set of linear difference equations in temperature was obtained. The solution of this set of equations gave a good approximation of the temperature field obtained from experiment.

It was also found that the largest stable time step for the linear equation could be computed from stability criteria for the heat equation since in this instance the fluid velocities have no effect on the allowable time step.

The above new findings were explained in part by a matrix method of stability analysis. 200 pages. $2.60.

The items following each abstract are: the number of manuscript pages in the dissertation, its cost on microfilm, and the Library of Congress card number. Enlargements 5-1/2 x 8-1/2 inches, 4 cents per page. No postage is charged if check or money order accompanies order.

PROPOSED NEW PROCESS FOR THE MANUFACTURE OF LACTIC ACID

(L. C. Card No. Mic 58-964)

Alberto Enrique Molini, Ph.D.
University of Michigan, 1957

The research problem deals with a quantitative study of the feasibility of developing a basicly new process for the manufacture of lactic acid. The process consists of the following steps:

1. Fermentation: A new method for the commercial fermentation of lactic acid is proposed. The fermentation is performed in such a way as to obtain lactic acid in the acid form rather than as a salt which requires subsequent regeneration. In order to accomplish this, the common ion effect of lactate salts upon the extent of ionization of lactic acid is utilized. This is substituted for the usual neutralization with calcium carbonate.
2. Extraction: The acid lactate produced in the fermentation is recovered by means of a selective solvent.
3. Distillation: The solvent used in the liquid-liquid extraction is distilled from the lactate-rich solvent phase in order to obtain the lactic acid.
4. Recirculation: The extracted liquor is recycled back to the fermentor in order to completely ferment any excess sugar and to reuse the lactate ion buffer.

The above steps were studied in a quantitative fashion during the course of the experimental program.

The fermentation phase of the research problem involved the study of different variables upon the fermentation rates, acid lactate concentration and the pH range of the fermentation. The variables studied were: malt sprouts and substrate concentrations, fermentation temperature, lactate ion buffer concentration and different types of lactate salts. The effect of each one upon the fermentation rates, acid lactate concentration and range of the fermentation pH is presented. The results show that it is possible to perform the fermentation as proposed previously.

The extraction phase of the research determined that it was possible to extract the acid lactate directly from the fermented liquor with either n-butyl or iso-amyl alcohols as solvent. The fermented liquors were not purified prior to the extraction.

The distillation phase is feasible as has been conclusively shown in the recent literature.

The recirculation phase of the research disclosed an inhibition effect of n-butyl and iso-amyl alcohols upon the fermentative bacteria. An attempt was made to adapt the fermentative bacteria, Lactobacillus delbrueckii, to the presence of n-butyl and iso-amyl alcohols. The results demonstrate that it will be necessary to remove the solvent from the raffinate prior to returning it to the fermentor.

As a result of the experimental program it is concluded that it is definitely possible to develop the new process for the manufacture of lactic acid originally described in this thesis. 144 pages. $2.00.

THE DEHYDROGENATION OF ETHANE TO PRODUCE ETHYLENE AND ACETYLENE, USING SULFUR AS A DEHYDROGENATION AGENT

(Publication No. 25,458)

Ralph Eugene Morningstar, Ph.D.
The Ohio State University, 1952

INTRODUCTION

Ethylene and acetylene are very important chemical raw materials for the manufacture of a large variety of chemical compounds. Both these gases have been prepared from petroleum sources, although at present the manufacture of acetylene from calcium carbide is still the standard method of preparation. Ethylene is prepared by thermal cracking of ethane, and in certain cases by partial combusion of ethane. Acetylene may be produced from hydrocarbons ranging from methane to light oils by reaction in an electric arc.

THERMODYNAMICS

Thermodynamically, both ethylene and acetylene are unstable at the temperatures required for the thermal cracking of ethane, and their formation is probably an intermediate step in the complete cracking of ethane. To secure appreciable yields of either gas, rapid removal from the reaction zone is necessary. This is accomplished commercially by quenching the reaction products. Thermodynamic equilibrium in the system ethane-ethylene-acetylene-hydrogen can be calculated readily on the assumption that reactions are carried out under conditions in which no further decomposition occurs. Under these conditions, the effect on the equilibrium of added materials which will react with the hydrogen may be calculated. This was done in the case where sulfur was added to the gas mixture, and since the sulfur may react with the hydrogen to form hydrogen sulfide, the equilibrium was displaced in the direction of greater unsaturation. Thus it appeared thermodynamically that the use of sulfur as a hydrogen acceptor would substantially increase the yield of unsaturates from ethane. It would also appear that sulfur, being a milder oxidizing agent than oxygen, might offer advantages over the latter in partial oxidation processes.

EXPERIMENTATION

Apparatus was set up to study the reaction of ethane and sulfur. This consisted of an ethane source and metering system, a vaporizer in which the ethane was passed through hot molten sulfur, and a reaction zone. The ratio of ethane to sulfur was controlled by adjusting the heat influx to the vaporizer. The reaction zone was a one-inch porcelain tube in an electric combustion furnace with a heating zone 14 inches long. The temperature of the furnace was controlled by appropriately varying the voltage to the heating element.

Analysis of the furnace exit gas was accomplished by a combination of standard and special absorption and combustion techniques. Analysis was made for ethane, ethylene, acetylene, methane, hydrogen, and hydrogen sulfide. In preliminary studies in which the method of analysis was worked out, organic sulfur was found not to be present in appreciable quantities. On the basis of the above analysis

and a hydrogen balance over the system, the conversion of the input ethane to ethylene and acetylene was calculated.

The conversion of ethane to ethylene and acetylene was studied as a function of the ratio of sulfur to ethane, the temperature of the reaction zone, the space velocity, and the use of catalysts. In addition, the reaction of ethylene and sulfur was also studied as a function of ethylene:sulfur ratio and the temperature of the reaction zone. A summary of the observations made during these studies follows.

The formation of ethylene from ethane.

It was found that ethylene could be produced from ethane in good yield in the absence of catalysts. A maximum conversion of 50 per cent was observed at a temperature of 1610° F. and a molar ratio of sulfur:ethane of 0.2. Over the range of sulfur:ethane of 0.0-0.8 moles (as S_1) / mole, the conversion to ethylene was independent of the sulfur present; at higher sulfur contents the conversion to ethylene dropped off.

The conversion to ethylene went through a maximum with temperature at about 1600° F. at all the sulfur:ethane ratios studied. Below 1600° F. unreacted ethane was present in the exit gas; above 1600° F. further dehydrogenation to form acetylene occurred. Above 1700° F. carbonization also was appreciable, so that the range above 1700° F. was not investigated.

The formation of acetylene from ethane.

It was found that acetylene could also be formed from ethane in the absence of catalysts. In this case, however, the yield varied directly with the sulfur:ethane ratio, a maximum yield of 50 per cent being obtained at 1565° F. and a ratio of 1.4, the highest ratio studied. On the other hand, the conversion to acetylene was substantially independent of temperature in the range 1200-1700° F., except that at the highest temperatures and the highest sulfur:ethane ratio, the conversion decreased somewhat with increasing temperature, presumably due to carbonization.

Illustrative data on the conversion of ethane to ethylene and acetylene are presented in Table I.

Table I

Conversion of Ethane to Ethylene and Acetylene

Input Ethane Flow - 200 c.c./min.			
$S:C_2H_6$	Temp. °F.	Per Cent Conversion to Ethylene	Per Cent Conversion to Acetylene
0.02	1280	8.0	0.0
0.35	1270	11.3	9.1
0.91	1265	13.0	22.1
0.06	1445	32.3	0.6
0.15	1440	23.2	6.8
0.65	1435	29.0	13.0
0.00	1560	46.5	6.2
0.59	1555	44.2	17.6
1.00	1565	44.8	32.9
1.33	1550	35.7	47.6
0.19	1615	48.8	14.7
0.29	1605	51.0	13.0
0.00	1690	14.7	9.5
0.64	1690	14.7	19.9
1.63	1700	2.3	42.0
0.11	1810	4.5	23.2

The formation of acetylene from ethylene.

A series of experiments was conducted in which ethylene was substituted for ethane in the inlet gas. In this case it was found that the conversion to acetylene was proportional to the sulfur:ethylene ratio, and substantially independent of temperature in the range studied. It was also observed that much more carbonization occurred than when ethane was used as the feed gas. The yield of acetylene was much lower from ethylene than from ethane, a maximum yield of 30 per cent being obtained at 1560° F. and a sulfur:ethylene ratio of 1.4. Illustrative data are presented in Table II.

Table II

Conversion of Ethylene to Acetylene

Input Ethylene Flow - 200 c.c./min.		
$S:C_2H_4$	Temp. °F.	Per Cent Conversion to Acetylene
0.00	1330	8.7
0.38	1335	12.5
1.05	1325	19.5
0.01	1575	1.6
0.59	1560	14.1
1.35	1560	28.7

Effect of space velocity on conversion of ethane to ethylene and acetylene.

At a temperature of 1600° F. and a sulfur:ethane ratio of 1, the contact time in the reactor was varied from 1.2 to 6.2 seconds. Over this range no trend was observed; the conversion to ethylene passed through a minimum at 3 seconds and 36 per cent conversion, and the conversion to acetylene passed through a maximum at 2 to 3 seconds and 42 per cent conversion. The contact time for the experiments described in Tables I and II was about 6.2 seconds.

Effect of catalysts.

Three catalysts were investigated for this system:

1. Impure activated alumina (Porocel).
2. Chromium oxide on Alcoa aluminum oxide.
3. Lump Pumice.

None of these catalysts offered any advantage over the use of the empty reactor tube, except that in the lower temperature range (1450° F.) higher conversions to both ethylene and acetylene were obtained in the presence of lump pumice. This effect was not observed at 1600° F. The conversions to acetylene and ethylene in the presence of pumice at 1450° F. were lower than those obtained in the absence of catalysts at 1600° F., so that even in this case the catalyst is of doubtful value.

DISCUSSION

The formation of ethylene from ethane even in the presence of sulfur vapor appears to be due largely to thermal cracking, with little or no ethylene formed by the reaction of ethane and sulfur. The presence of sulfur appears to lower the conversion to ethylene, presumably by reacting further with the ethylene formed to form acetylene or carbon. On the other hand, the formation of acetylene from ethane is strongly favored by the presence of sulfur vapor. This suggests that the principal reaction between ethane and sulfur is the following:

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$$C_2H_6 + S_2 \rightarrow C_2H_2 + 2H_2S$$

where S_2 represents a mole of diatomic sulfur vapor. It is possible that an intermediate ring structure is formed by hydrogen bonding with the sulfur to form a carbon-hydrogen-sulfur intermediate, which dissociates to yield the above products.

In the reaction of ethylene with sulfur, acetylene is formed, but in lower yields than was obtained from ethane. Carbonization is more severe when ethylene is used as the input gas. Ethylene is probably not an intermediate in the reaction to form acetylene, but in fact the reaction of ethylene and sulfur very likely produces elemental carbon, as by the reaction:

$$C_2H_4 + S_2 \rightarrow 2C + 2H_2S$$

The effect here was not as prominent as the reaction of ethane and sulfur, since sulfur also reacted with the ethylene to form acetylene. In general, however, the reacting ratio of sulfur to ethane or ethylene appeared to be two atoms of sulfur per mole of hydrocarbon. In most cases a lower ratio was used in the experimental work, since above a ratio of about 1.4 carbonization tended to occur.

The thermal cracking of ethane to ethylene was found to be less critical than had been anticipated from published information, and was carried out in good yields at contact times appreciably greater than those cited as usual practice.

The conditions of reaction of ethane with sulfur were found not to be critical from the standpoint of operation. Over the range of conditions studied carbonization was not appreciable; at higher temperatures or sulfur concentrations, however, carbonization did occur.

Catalysts were found to be of little value in this work. In the case of lump pumice, it was found that a high conversion could be obtained at a slightly lower temperature. However, the use of a catalyst would increase the tendency of the reactor to plug with carbon, hence catalysts are not recommended for this work.

CONCLUSIONS

Ethylene can be produced from ethane in good yields by thermal cracking. The addition of sulfur vapor to the reaction zone does not appreciably change the yield of ethylene, but the sulfur reacts with the ethane to form acetylene and hydrogen sulfide. Yields of 50 per cent of either ethylene or acetylene can be obtained by proper choice of conditions. Catalysts do not improve the yield of either gas. 178 pages. $2.35. Mic 58-4821

Abstract published by special arrangement with The Ohio State University.

THE EFFECT OF TEMPERATURE ON THE DETONATION CHARACTERISTICS OF HYDROGEN-OXYGEN MIXTURES

(L. C. Card No. Mic 58-967)

Morton Peter Moyle, Ph.D.
University of Michigan, 1957

The detonation characteristics of hydrogen-oxygen mixtures were investigated theoretically and experimentally over a range of compositions from 25 to 80 percent hydrogen, a range of pressures from one-half to two atmospheres, and a range of temperatures from 160 to 500 degrees Kelvin. Detonation velocities were calculated assuming that equilibrium is attained behind the detonation front and that the detonation wave travels at the speed of sound with respect to the burned gases.

The theoretical results indicate that variations of initial pressure and initial temperature have little effect on the detonation velocity. They further indicate that the final temperature varies only four percent when the initial temperature is varied 250 percent. The equilibrium products H, OH, and H_2O increase as the initial hydrogen concentration is increased to stoichiometric and then diminish. The concentration of the OH ion attains a maximum value of 14.50 percent.

The experimental results confirm the theoretical analysis. Over the temperature range investigated, the deviation of the experimental velocities from the theoretical values was less than one percent. The effect of tube size was included in the experimental investigation in order to extrapolate the velocities to an infinite diameter tube for comparison with the theoretical values.

Spark schlieren photographs of the detonation wave show that the structure of the wave approaches the theoretical model near stoichiometric mixtures. At 39.00 percent hydrogen however, the detonation front begins to thicken and at 28.85 percent it has degenerated into a complicated zone of interacting shock waves and turbulent combustion.

Detonation Mach numbers were found to vary approximately as the reciprocal of the square root of the absolute temperature of the unburned mixture. The detonation Mach numbers were used to calculate the pressures developed in detonation. The pressures developed at 160 degrees Kelvin were three times those developed at 480 degrees Kelvin. The collision of the wave at a solid boundary may be expected to increase the pressure developed by a factor of 2.6. For a 55.04 percent hydrogen-oxygen mixture initially at 160 degrees Kelvin, the pressure ratio after collision with a solid boundary was found to be 82.9.

The excellent agreement between theory and experiment found in this investigation corroborates the validity of the hydrodynamic theory of detonation over a wide range of initial conditions. 144 pages. $2.00.

SOME EFFECTS OF HEAT TRANSFER SURFACES OBSERVED IN NATURAL CONVECTION AND NUCLEATE POOL BOILING HEAT TRANSFER

(L. C. Card No. Mic 58-1161)

Robert Leland Nickelson, Ph.D.
University of Minnesota, 1957

Adviser: George W. Preckshot

An investigation was made of the effects of various metal surfaces on natural convection and nucleate boiling heat transfer in an attempt to clarify the basic mechanisms of boiling. The heating surfaces were electrically heated 18 or 20 gauge wires of copper, silver, and gold approximately 12 inches long. Temperature measurements

were made by resistance thermometry with a Kelvin bridge circuit. The test liquid was spectroscopic grade carbon tetrachloride.

Great care was taken to keep the heat transfer system free of foreign nuclei such as oil or grease and non-condensible gases. The system was constructed entirely of glass and metal and was evacuated to 10^{-6} millimeters of mercury pressure at 450° C to remove volatile materials and adsorbed gases before each run. Oxides were eliminated from the heating surfaces by reduction in a hydrogen atmosphere prior to evacuation. The carbon tetrachloride was refluxed under reduced pressure to remove dissolved gases and was transferred directly to the evacuated heat transfer system and sealed off. The effects of surface roughness on boiling was minimized by selecting heat transfer wires of very nearly the same micro-roughness.

Heat transfer experiments were then conducted at absolute pressures of one-half, one, and one and one-half atmospheres. A visual count of the number of nucleating sites was made at low heat fluxes where the number of sites were not too numerous. These counts could be made only up to approximately ten per cent of the critical flux.

Very high temperature excesses were required in order to initiate boiling which demonstrated that extraneous nuclei had been successfully removed from the system. Under certain conditions, the natural convection heat flux and temperature excess were high enough that film boiling developed without passing through the nucleate boiling region. Natural convection heat transfer was unaffected by the chemical nature of the surfaces.

In the nucleate boiling region, the heat flux curves were definitely effected by the chemical nature of the heat transfer surface. From the count of nucleating sites, it was shown that the effects are reflected primarily by the active nucleus population per unit area. The active nucleus population per unit area was a function only of the chemical nature of the surface and the pressure excess over the pressure range studied.

The contribution of each nucleating site to the total heat flux is a function of the pressure, pressure excess, and the active nucleus population per unit area for any given liquid. Different metals effect the contribution per nucleating site only through the active nucleus population. For a given surface, the contribution per active nucleus is independent of the temperature excess, and increases with decreasing total pressure. Since very high superheats were reached before boiling took place, it is highly improbable that a liquid-metal fracture nucleation mechanism could take place during normal boiling. The most probable mechanism is the growth of bubbles from vapor filled cavities in the heating surface. 129 pages. $2.00.

THE EFFECT OF PRESSURE ON AZEOTROPES

(L. C. Card No. Mic 58-1354)

Dominic Frank Palazzo, Ph.D.
Columbia University, 1955

The effect of pressure on the composition and boiling point of four binary azeotropes has been studied. The range of pressures over which the systems were tested were:

System	Range mm Hg.
isobutanol-benzene	206 - 12,930
n-propanol-benzene	342 - 18,200
ethanol-benzene	209 - 19,160
isopropanol-benzene	196 - 15,380

At atmospheric and subatmospheric pressures a glass fractionating column was used and the pressure was controlled by an automatic manostat. A sample having a composition close to the expected azeotrope was put in the still pot and the column operated at total reflux until it reached steady state as determined by constant pressure and temperature. An adiabatic jacket around the column was maintained about 5°C below the vapor temperature. Samples were drawn at constant reflux $\frac{L}{V} = 0.95$.

At superatmospheric pressure a stainless steel column packed with 1/8" nichrome helicies was used. Here again an adiabatic jacket around the column and still head was heated so that the air spaces between the jacket and column were about 5°C lower than the vapor temperature. The system was operated at total reflux until steady state was reached. Samples were then drawn from a sampling chamber which could be isolated and vented to the atmosphere. All samples were analyzed with a refractometer.

The data obtained during this investigation were compared with those available in the literature and were found to agree within the following limits of composition:

System	Atmospheric Pressure mole %	Superatmospheric Pressure mole %
n-propanol-benzene	0.2-2.7% (max.)	3% (max.)
ethanol-benzene	0%	2-4% (max.)
isopropanol-benzene	0.1%	4-5% (max.)
isobutanol-benzene	1.8%	no literature values

The vapor pressure vs. temperature for isobutanol has been measured between 760 and 10,230 mm Hg.

A study of the effect of pot composition and reflux ratio on the composition of the azeotrope obtained at the top of the column has also been made. From the results of the tests made it was concluded that when investigating azeotropes having a composition between about 8% to 90% of a component a reflux ratio $\frac{L}{V} = 0.95$ and a pot composition within 5-10% of the azeotrope would give reliable results.

Several correlations proposed in the literature relating composition, temperature and pressure were tested with the author's experimental results. It was found that only the equation of Othmer and Ten Eyke, which states composition is a linear function of the pressure on log - log coordinates, gives satisfactory agreement with the experimental results over the pressure range studied.

An equation relating composition and boiling point of the azeotrope was developed. It was derived from the van Laar and the Clausius-Clapeyron equations and has the form

$$\frac{ABx_1^2 - Bx_2^2}{(Ax_1 + x_2)^2} = C + DT$$

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where A, B, C and D = constants
x_1 = mole fraction of component "1" in the azeotrope
T = absolute temperature

On the average the agreement with experimental data was better than the relationships proposed in the literature. 145 pages. $2.00.

THE HYDROGENATION OF CARBON MONOXIDE ON A STEEL CATALYST

(L. C. Card No. Mic 58-983)

Ralph Howard Schatz, Ph.D.
University of Michigan, 1957

The hydrogenation of carbon monoxide on a C1013 carbon steel catalyst to form methane and other light hydrocarbon gases was studied over the temperature range 800° to 1250° F at a pressure of 31 atmospheres using feed gas containing from 30% to 56% carbon monoxide. The primary aim of the investigation was to determine the optimum conditions of temperature and feed gas composition for the production of high BTU gas. Information was desired concerning the amount of carbon deposited on the catalyst surface at various reaction conditions.

A secondary objective of the research was to investigate the use of air oxidation as a method for removing carbon deposited on the catalyst and for reactivating catalyst poisoned by sulfur compounds present in the feed gas.

Feed gas at a rate of 5 SCFH was passed over a catalyst bed of 1/8-inch steel balls supported in an electrically heated brass-lined steel reactor fabricated from a one-inch-diameter, schedule-80 stainless steel pipe. At the end of experimental runs, the catalyst bed was removed from the reactor and any deposited carbon was weighed.

Samples of feed and product gas collected during experimental runs were analyzed with an analytical mass spectrometer.

Carbon steel (C1013) was an effective methanization catalyst, exhibiting a large increase in its ability to catalyze the reaction between carbon monoxide and hydrogen to form methane, water, and carbon dioxide as the temperature was raised from 900° to 1040°F. The catalyst activity reached a maximum at 1100° to 1150°F, depending upon the feed composition, and then declined with a further increase in temperature.

Increasing the carbon monoxide concentration of the feed gas, up to a value of 50%, resulted in reduced dilution of the product by unreacted hydrogen and carbon monoxide. At higher carbon monoxide concentrations, the sum of the unused hydrogen and carbon monoxide in the product began to slowly rise, accompanied by a decline in methane formation. Increasing the feed carbon monoxide concentration resulted in an increase in the percentage of the carbon monoxide converted to carbon dioxide and a decrease in the percentage converted to methane. When feed gas containing more than 50% carbon monoxide was used, the conversion of carbon monoxide to carbon dioxide exceeded the conversion to methane.

The optimum conditions of temperature and feed gas composition for the synthesis of a product of the highest heating value at 31 atmospheres pressure and a space velocity of 0.10 mole/hr-sq ft using a steel catalyst were determined to be:

Temperature:	1090° to 1150° F
Percent CO in feed gas:	47% to 52%

The heating value of the product ranged from 735 to 745 BTU/SCF after water and carbon dioxide were removed.

Carbon deposition was increased by increasing the carbon monoxide content of the feed gas. The rate of carbon deposition increased rapidly as the temperature was raised from 900° to 1000°F. For a particular feed composition, the region of heaviest carbon deposition occurred over the temperature range 980° to 1020° F. As the temperature was further increased, the amount of carbon deposition decreased substantially.

Carbon was removed from the catalyst by oxidation with air without deleterious effect on the catalyst activity. Steel catalyst was found to be poisoned by carbonyl sulfide present in the feed gas, but oxidation with air reactivated the catalyst. 130 pages. $2.00.

RECTIFICATION OF TWO HYDROCARBONS IN THE PRESENCE OF WATER AS A THIRD INSOLUBLE COMPONENT

(Publication No. 25,449)

Carl John Setzer, Jr., Ph.D.
The Ohio State University, 1952

INTRODUCTION

In certain types of commercial distillation columns, fractionation takes place in direct contact with an additional insoluble component. Particularly representative of this case are the operations commonly known as steam stripping and azeotropic distillation. Open steam is widely employed in the coal tar and petroleum industries for the recovery and purification of such volatile constituents from benzolized wash oils as light aromatics, benzene, toluene, and xylene; for the recovery of gasolene from natural gas by absorption and subsequent steam distillation from absorber oils; and for the separation of many crude petroleum mixtures into fractions of narrower boiling ranges. Azeotropic distillation may also have two liquid phases present in the column. However, this operation differs from steam distillation in that the third component added to the column may be partially miscible in the other two components and thereby alters the vapor-liquid relationship between the original components.

In a distillation where two phases are present on the plates, the mechanism taking place in the column is not well understood, and adequate theoretical treatment has been limited partially by the lack of vapor-liquid equilibrium data for the systems involved. Nevertheless, distillation operations mentioned above possess at least two important features in common. In the vapor phase, the third compound may be present as a relative inert component through which the active components must diffuse, and in the liquid phase the existence of the third compound as an immiscible phase tends toward the formation of layers at low vapor velocities and to the formation of a more heterogeneous liquid overflow at higher vapor

velocities. To what extent such factors effect the efficiency of separation, and therefore the number of plates required to effect a given separation, is a consideration of practical and theoretical interest.

Since very little data are available in the literature on plate efficiencies during the distillation of heterogeneous mixtures, a study of the separation of ethylbenzene and o-dichlorobenzene was undertaken with a view toward getting some quantitative data under both normal and steam distillation conditions.

SCOPE OF THIS INVESTIGATION

It was the purpose of this investigation to determine the effect of the addition of a third insoluble component upon the efficiency of separation of two miscible compounds. The two miscible compounds used were ethylbenzene and o-dichlorobenzene and the immiscible component was water. The distillation column used in this study is located at the Chemical Engineering Department of the Ohio State university.

Three series of runs, differing only in the amount of the water phase returned to the column in the reflux, were made using the three component two phase system. In each series of runs, three vapor-liquid ratios for the hydrocarbon phase and four superficial vapor velocities were used. The composition of the hydrocarbon phase was varied to give a wide range of concentrations. A two-component system of ethylbenzene and o-dichlorobenzene was used to make a fourth series. Owing to the limitations of the equipment, only runs high in ethylbenzene and at low vapor velocities could be obtained.

In order to evaluate the column performance it was necessary to determine the vapor-liquid equilibrium relationships at one atmosphere for the single phase system of ethylbenzene and o-dichlorobenzene and for the two phase system of ethylbenzene, o-dichlorobenzene, and water.

SUMMARY

The results of this work indicated:

1. The presence of the immiscible phase on the plates, compared to an ordinary distillation, adversely effected the column performance. For example, for runs of equal hydrocarbon through-put and over the same hydrocarbon concentration range, the over-all efficiency was reduced from 80.2 for an ordinary distillation to 42.3 per cent for a steam distillation. For a steam distillation at a vapor velocity equal to that of the ordinary distillation, the over-all efficiency was 20.3 per cent. Murphree plate efficiencies and the Plates Equivalent to a Transfer Unit were effected to the same extent.

2. The effect of increasing the vapor velocity was to increase the over-all efficiency and the Murphree plate efficiency and to decrease the Plates per Transfer Unit. The effect of vapor velocity was more pronounced when the hydrocarbon was the ligher phase on the plates.

3. The effect of increasing the relative amount of the water phase on the plate was to decrease the over-all efficiency and the Murphree plate efficiency and to increase the Plates per Transfer Unit. This effect was decreased by an increase in the vapor velocity.

4. When the hydrocarbon was the lighter phase on the plates, the Murphree plate efficiencies and Plates per Transfer Unit values at constant vapor velocities reached a minimum and maximum respectively at an M_a value of 0.26.

5. When the hydrocarbon was the heavier phase, both the Murphree plate efficiency and the Plates per Transfer Unit values increased with an increase in M_a, the average slope of the vapor-liquid equilibrium line.

6. Satisfactory correlations were obtained by plotting the Murphree plate efficiencies and Plates per Transfer Unit values versus the integrated average slope of the equilibrium curve, M_a, over the concentration range on the plate.

7. Satisfactory correlations were obtained by plotting the Murphree plate efficiencies for the top plate versus the relative amount of the hydrocarbon to water phase refluxed to the plate.

RELATED LITERATURE

Very little data are available in the literature on plate efficiencies during the distillation of heterogeneous mixtures. During the operation of an alcohol dehydrating column Clark and Guinot[1] found that the boiling liquid removed from the upper plates was heterogeneous and that the efficiency of the plates was apparently undiminished by the heterogeneity of the boiling liquid. They believed that this was due to the violent agitation produced on the plates by the rapid bubbling of vapors through the liquid. In discussing this work Underwood[2] pointed out that in some cases it had been found that the presence of two liquid phases on the plates adversely affected the plate efficiency.

In testing a continuous petroleum still operating with open steam, Goodliffe[3] found that efficiencies based on the equations developed by Murphree varied from -50 to as high as 164 per cent for different ranges of components. The over-all column efficiency was found to be 18.4 per cent. He attributed this extraordinarily low figure to the hindering effect of the water flooding each tray and thus preventing contact between the hydrocarbon vapors and the liquid. If quiescent conditions had been obtained on each plate, water would entirely have filled the trays to a depth slightly greater than the height of the over-flow wier. However, turbulence provoked by the passage of vapors through the liquid improved this extreme condition.

Bloomfield[4] also obtained fairly low plate efficiencies, from 30 to 40 per cent, under somewhat similar circumstances as those of Goodliffe. He believed that the main reason for the lov efficiencies was that the steam and water formed films at the interface between the vapor and oil which would greatly hinder the diffusion of hydrocarbon vapor into and out of the liquid. Unfortunately in these cases, the efficiencies of the plates without the presence of steam were not determined.

Schoenborn, Koffolt, and Withrow,[5] using the system of trichlorethylene, toluene, and water, studied the problem of rectification in the presence of an insoluble component. They found that the column efficiency was not effected by the presence of the immiscible water phase.

EQUIPMENT AND EXPERIMENTAL PROCEDURE

All tests were made on a three-plate glass-walled bubble-cap column of 12 inch outside diameter and 10 inch plate spacing. Each plate was equipped with 10 bubble caps arranged in three rows, and was provided with sampling tubes.

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The method of operation consisted of charging the kettle with an ethylbenzene, o-dichlorobenzene, and water mixture of desired composition. The vapor-liquid ratios of both phases were set at the desired values by means of the appropriate valves. The reflux was preheated and returned to the top plate, and the portion of condensate not refluxed was returned to the kettle.

When steady state conditions as indicated by consistancy of temperatures in the equipment had existed for one-half an hour, liquid samples were withdrawn from the plates.

The liquid analysis was performed with a Bausch and Lomb Abbe Refractometer, a previously determined refractive index-composition curve being used for the conversion of the refractive index measurements.

PHYSICAL PROPERTIES OF MATERIALS

The two hydrocarbons selected for this research were ethylbenzene and o-dichlorobenzene. The main factors effecting this selection were:

1. The two materials were obtainable at a high degree of purity.
2. The two compounds were practically insoluble in water.
3. There was a sufficiently wide range in volatility so that a marked change in concentration could be noted from plate to plate in the distillation column.
4. The difference in refractive index afforded an accurate method of analysis for mixtures of the two compounds.

During the course of this investigation it was necessary to measure the following physical properties of these two compounds:

1. Refractive indexes of mixtures.
2. Vapor-liquid equilibrium relationships.
3. Density of the compounds at elevated temperatures.
4. Vapor pressure of the two components.

CALCULATIONS

The performance of the column was evaluated by the three standard methods in distillation: first, by determining the Over-all column efficiencies; second, by calculating the Murphree plate efficiencies; and third, by determining the number of plates equivalent to a transfer unit.

DISCUSSION OF RESULTS

In analysing the problem of distilling two hydrocarbons in the presence of water as a second immiscible phase, one would expect that the performance of a plate column would be dependent upon the following factors:

1. The relative amounts of the hydrocarbon and water phase present on the plates.
2. The relative density of the two phases; that is, whether the hydrocarbon is the upper or lower phase.
3. The vapor velocity through the column.
4. The composition of the hydrocarbon phase, or, in other terms, the slope of the vapor-liquid equilibrium curve. These factors are supported by the correlations of experimental results.

Any attempt to explain why these factors effect the column performance in the manner indicated by the correlations requires a knowledge of the physical relationship of both the hydrocarbon and water phase on the plates. Since the experimental column was equipped with glass walls, it was possible to observe the conditions on the plates. Thus one could quantitatively determine the effect of changes in operating variables on the condition of the two phases on the plates.

Owing to the difference in volatility between ethylbenzene and o-dichlorobenzene, the relative amount of hydrocarbon to water in the vapor increased with an increase in the concentration of ethylbenzene. Assuming the two phases were completely immiscible and equilibrium conditions existed, for pure ethylbenzene the distillate would contain 3.03 mols. of water per mol. of ethylbenzene, and for dichlorobenzene the distillate would contain 12.4 mols. of water per mol. of o-dichlorobenzene. Therefore, when the operation of the column differed only in the concentration of the hydrocarbon phase, the relative amount of water to hydrocarbon was greater at the lower concentrations of ethylbenzene. This factor was easily observed during the operation of the column.

Owing to the stripping action of the steam the amount of hydrocarbon flowing to successively lower plates was decreased, thus causing an increase in the relative amount of water present on the plates. At low concentrations of ethylbenzene the relative amount of water on the plates was so great that it was difficult and sometimes impossible to collect a sample of the hydrocarbon phase for analysis. Even for runs in which only the hydrocarbon phase was refluxed to the column, water was always present owing to the condensation of water vapor on the plates caused by the steam stripping of the hydrocarbon.

At high concentrations of either hydrocarbon there was a tendency toward the formation of distinct phase layers during operation. When the two phases were nearly equal in density (around 70 per cent ethylbenzene), the phases tended to be more homogeneous. The tendency toward the formation of layers was also greatly dependent upon the vapor velocity, as agitation on the plate was increased with an increase in vapor velocity.

The relative amount of each phase on the plates was governed by the reflux ratios of the hydrocarbon and water phases. Owing to the condensation of water vapor, this ratio changed on the lower plates of the column. Thus correlations involving the amount of each phase present on the plate are only for the top plate to which the flow of reflux was known. To calculate the relative amounts of each phase present on the plates, it was necessary to assume that both phases traveled across the plate at the same rate. This assumption was probably valid for runs of high vapor velocity, where agitation caused by the vapors maintained the two phases in a mixed state. However, at lower velocities the two phases tended to separate; thus this assumption probably did not hold true. Visual observations were made in an attempt to determine the relative amount of separation on the plates. Although only rough estimates could be made, there appeared to be more of the lower phase present at lower vapor velocities.

To study the effectiveness of the contact between the vapor and the hydrocarbon phase on the plates, the ratio of the actual mols. of water vapor per mol. of hydrocarbon vapor to the theoretical number of mols. of water vapor per mol. of hydrocarbon vapor leaving the top plate of the column were calculated. The actual number of mols. of water per mol. of hydrocarbon was calculated from the measured flows of the two phases, and the theoretical

The items following each abstract are: the number of manuscript pages in the dissertation, its cost on microfilm, and the Library of Congress card number. Enlargements 5-1/2 x 8-1/2 inches, 4 cents per page. No postage is charged if check or money order accompanies order.

of water per mol. of hydrocarbon was calculated by assuming the phases to be completely immiscible and that Raoult's Law applied for the mixture. This ratio was plotted as a function of M_a. This curve indicated that the ratio was fairly constant over the range where the hydrocarbon was the lighter phase, then increased with increasing M_a values in the range where the hydrocarbon was the heavier phase. This correlation is what one would expect as more intimate contact of the hydrocarbon phase with the vapor could be achieved when the hydrocarbon was the lighter phase. As the M_a values increased, the density of the hydrocarbon became increasingly greater than the density of water, and, as pointed out before, the relative amount of hydrocarbon on the plate decreased. Thus it was increasingly possible for the vapors to pass through the bubble caps and not contact the hydrocarbon phase on the plates. This would account for the decreased efficiencies at the higher values of M_a.

Three runs differing only in the reflux ratio were made for the two component systems of ethylbenzene and o-dichlorobenzene. Owing to the limitations of the equipment, the runs were limited to a high concentration of ethylbenzene and a vapor velocity of 0.63 feet per second, which was slightly greater than the minimum velocity required for stable operation of the column. The hydrocarbon flow for these experiments was about the same as that obtained in steam distillation runs at vapor velocities of 2.5 feet per second at similar concentrations. Based on equal hydrocarbon flow, the column performance for the two types of distillation are compared in the following table.

	Ordinary Distillation	Steam Distillation	
		No water in reflux	All water in reflux
Over-all Efficiency	80.2 %	68 %	47 %
Murphree Efficiency	112.8 %	67 %	51 %
Over-all P.T.U.	0.47	1.01	1.17

Thus in all cases the column performance was adversely effected by the addition of water to the distillation of the two components. 100 pages. $2.00. Mic 58-4822

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Abstract published by special arrangement with The Ohio State University.

MISCIBILITY OF NATURAL GAS AND CRUDE OIL

(L. C. Card No. Mic 58-1466)

Donald Leo Stinson, Ph.D.
University of Michigan, 1957

The object of this work was to study the factors controlling the use of high pressure gas to recover volatile crude oils from natural formations. Particular attention was paid to the vaporization of the crude oil into natural gas and to those conditions where the crude oil would be miscible with the natural gas.

All of the experimental work was conducted in glass windowed cells mounted in suitable air baths for temperature control.

Four different experimental procedures were used to obtain information on the behavior of natural gas and crude oil systems: 1) a known amount of gas was added to a constant volume system at constant temperature and the resulting pressures and liquid volumes were measured, 2) the phase diagrams of a series of constant composition mixtures were determined, 3) the vapor phase was removed from a constant volume system to simulate natural depletion, and 4) the phase diagrams of several systems formed by injecting successive volumes of gas into a partially depleted system were determined.

The results from the constant volume experiments with two different gases indicate that systems containing as much as 32 volume per cent 50° API stock tank oil at 212°F can be changed into a single phase vapor at pressures slightly in excess of 5000 pounds per square inch absolute.

The volumetric and phase behavior of nine mixtures of separator oil and gas were determined for temperatures from 82 to 486°F. These systems represented gas-oil ratios varying from 701 to 10,540 standard cubic feet of separator gas per barrel of separator oil. The critical temperatures of these systems varied from over 400° F for systems with less than 1595 standard cubic feet of gas per barrel to below 100° F for the system containing more than 4850 standard cubic feet per barrel of oil. The measured saturation pressure varied from 100 to 8,200 pounds per square inch absolute.

During the depletion experiment the effluent gas was analyzed and the liquid compositions were calculated. The equilibrium constants obtained from this work were compared with those available from the literature.

The injection of a dry natural gas into the partially depleted system resulted in a single phase condition at a pressure exceeding the original saturation pressure.

Charts are presented to provide liquid type compressibility factors for condensate systems and two phase systems. These values are of interest in studying the pressure behavior of reservoirs.

The experimental results are used in conjunction with information available from the literature to predict the behavior of a very rich gas condensate under several types of cycling.

These predictions indicate that in the region over 3000 pounds per square inch absolute, cycling at the highest pressure possible will result in the maximum liquid production per unit of gas produced. In actual practice this advantage must be balanced against the larger volumes of gas required. 252 pages. $3.25.

THERMODYNAMIC PROPERTIES OF THE ZINC-CADMIUM SYSTEM BY EMF MEASUREMENTS

(L. C. Card No. Mic 58-1148)

Donald James Wynnemer, Ph.D.
University of Minnesota, 1957

Adviser: N. H. Ceaglske

The thermodynamic properties of the zinc-cadmium system were determined by measuring the electromotive force of a concentration cell between 700 and 900°C. with pure zinc as one electrode and the zinc-cadmium alloy as the other. The experimentally determined entropy of mixing agrees well with the ideal entropy of mixing. The experimentally determined heat of mixing agrees well with the following expression:

$$\triangle H = 2000N_{Cd}N_{Zn} + 290(-3N_{Cd}\,\ln N_{Cd} - 5.417N_{Cd} + 9N_{Cd}^2 - 5N_{Cd}^3 + 1.66N_{Cd}^4 - 0.25N_{Cd}^5)$$

with a corresponding maximum of 517 cal./gm.-mole of alloy at 0.527 mole fraction zinc.

The vapor-liquid equilibrium relationship for the system was calculated from the electromotive force measurements. The zinc-cadmium system deviates positively from Raoult's Law. The mole fraction of cadmium in the vapor phase in equilibrium with a liquid zinc-cadmium alloy is greater than that predicted from Raoult's Law up to 0.45 mole fraction cadmium in the alloy and in less than that predicted by Raoult's Law at higher concentrations of cadmium in the alloy. 72 pages. $2.00.

ENGINEERING, CIVIL

PLASTIC ANALYSIS OF NON-PRISMATIC MEMBERS

(L. C. Card No. Mic 58-1290)

Hashim Hussain Hamzawi, Ph.D.
Stanford University, 1958

Plastic analysis of steel structures having a uniform cross section has been given considerable attention during the past quarter of a century. Locations of plastic hinges in such structures are determined, normally with little difficulty, at sections of maximum bending moment. Little attention was given, however, to structures consisting of non-prismatic (or tapered) members. Plastic hinges in such members do not necessarily occur at sections of maximum bending moment. It is the purpose of this thesis to consider such problems and to develop formulas for locating the plastic hinges and for calculating the ultimate loads.

The analyses deal with tapered members having rectangular cross sections and I or box sections. Because these analyses are based on the assumption usually made in elementary strength of materials, the angle of taper of these members should not be large. Angles up to 20 degrees between the two faces of the member (included angle of taper) can be covered by these analyses without appreciable errors. This range, however, includes almost all tapered structural members commonly in use.

The stress-strain relationship of structural steel, in tension, is idealized by two straight lines, one of which represents the elastic range (with slope E) and the other represents the plastic range (with zero slope), thus neglecting the strain hardening range. Identical properties are assumed to hold for the steel in compression. The effects of shear, axial forces and repeated application of loads (shakedown) are not discussed here. In addition, it is assumed that all the members are so supported that lateral buckling and other forms of failure by instability are prevented.

Equations are derived for locating the plastic hinges in cantilever, propped cantilever (fixed-supported) and fixed end beams subjected to a concentrated load or a uniformly distributed load. Cantilever beams are analyzed also for several concentrated loads or different uniform loads or combinations thereof. Equations are also given for calculating the ultimate load whenever these equations happen to be simple to use. Otherwise the principle of virtual work is recommended for calculating ultimate loads.

Structures such as continuous beams having several spans and rigid and gable frames are analyzed under various loading and end conditions by using the results obtained from the analysis of cantilever, propped cantilever and fixed end beams. In cases where more than one load exists on these structures, these loads are assumed to be related to each other by a numerical factor (proportional loading). Analyses of structures other than those presented can be made in a similar manner.

Results of five experiments, conducted to supplement some of the theoretical analyses, are presented. The main object of these experiments was to confirm the fact that the plastic hinges, in a tapered member, can form away from the locations where they would normally appear if the cross section had been uniform. The results of these experiments were in almost perfect agreement with the theoretical predictions in both locating the plastic hinges and calculating the ultimate loads.

Several numerical examples are given throughout the thesis to illustrate the use of the theory for solving practical problems. 146 pages. $2.00.

ENGINEERING, ELECTRICAL

MINIMUM ENERGY TRIGGERING SIGNALS

(L. C. Card No. Mic 58-1375)

Lynn Allison Beattie, Ph.D.
University of Michigan, 1957

In switching problems the efficiency of the switching circuits is often of considerable importance. In the past the basic switching mechanism has been actuated by pulses or simple functions of voltage, current, or force, and efforts to obtain increased efficiency have led to the use of transistors, development of better relays, and the improvement of other components. This dissertation

considers, as an alternative or complementary approach to the problem, the optimization of the function of time which is used for triggering so as to minimize the energy required of the triggering signal.

The general problem of determining the optimum triggering signal for a lumped-constant, linear circuit is treated. The optimum signal is defined as that which produces a given current through, or a voltage across, a resistive output element at time t = T while at the same time requiring a minimum of energy from the generator driving the circuit. The output resistance is considered as characterizing the input terminals of a bistable element such as a thyratron, multivibrator, or a magnetic relay.

General equations characterizing the optimum signal are derived, and the conditions under which they are valid are noted. There are two pathological types of circuits for which characteristic equations are not obtained. However, both of these types of circuits are unrealistic in the sense that they do not allow for generator internal resistance or stray capacitance across the circuit input terminals. For realizable circuits and realizable generators a characteristic equation is obtained which is always valid.

Methods of solution of the characteristic integral equations are discussed, and it is shown that the Laplace transform can be used to reduce the integral equations into algebraic ones which are susceptible of simple solution. Finally, several sample problems are proposed and the solutions obtained. These examples, in addition to demonstrating general solutions, also demonstrate a method for finding the undetermined constants involved in the equations. 76 pages. $2.00.

MOTION OF SPORADIC-E PATCHES DETERMINED FROM HIGH FREQUENCY BACKSCATTER RECORDS

(L. C. Card No. Mic 58-1280)

Clayton Clark, Ph.D.
Stanford University, 1958

New evidence of the motion of Sporadic-E ionization has been obtained at Stanford University from records of ionospheric sounding equipment[27] which displays ground (or sea) backscatter as mirrored in ionospheric layers or reflecting clouds. Sporadic-E patches of relatively limited geographical extent often appear on the records of this apparatus and their growth and motion can be followed about 10 per cent of the time. In the virtually continuous three-year record studied, 2700 such patches were observed. The lifetime of the patches varied from a few minutes to a maximum of 10.5 hours with a mean value of 3 hours. Every patch was examined for indications of motion. Plots were made of the 251 cases which appeared to move, and speed and direction information was derived.

Speed and direction distributions are presented along with geographic, diurnal and seasonal occurrence information. The speed distribution is peaked at 250 km/hr with a very few cases as high as 1000 km/hr and a few cases less than 100 km/hr. The direction of motion is predominantly toward the west but patches were observed to move in other directions.

Speeds were found to agree generally with measurements of meteor trail drift and apparent ionospheric motion measured by radio fading methods. The westward direction of motion agrees with some measurements in Japan by radio fading techniques.

Supporting evidence of the reality of the observed motion was obtained from vertical-incidence sounding equipment.

A measure of speed change with height of occurrence of the E_s patch is obtained with an average value of 19 km/hr speed increase per km increase in height.

Evidence seems to indicate that Sporadic-E appears more patchy when viewed looking south and west from Stanford than when looking north and east. Experiments are suggested to determine if this is an ionospheric or earth-surface effect.

Evidence against E_s formation and motion by thunderstorms or electromagnetic radiation is presented. Evidence relating E_s formation and motion to turbulence and winds is presented and discussed. 114 pages. $2.00.

LINEAR SYSTEM APPROXIMATION BY MEAN SQUARE ERROR MINIMIZATION IN THE TIME DOMAIN

(L. C. Card No. Mic 58-920)

Elmer Grant Gilbert, Ph.D.
University of Michigan, 1957

The purpose of this study is to extend the theory and practicality of linear system approximation by mean square error minimization in the time domain. Consideration has been given to a completely general statement of the approximation problem and to the need for simplified computation procedures. As a result, many of the earlier restrictions of the mean square error method have been overcome.

The general procedure consists of expanding an approximate system function in a series of predetermined approximating functions and choosing the coefficients in this series to minimize a time weighted average of the squared response error.

Part One, which is devoted to the basic theory of the procedure, discusses first the approximation properties of the mean square error criterion. It is shown that the resulting frequency domain approximation is good except for possible large phase errors and that the effect of an arbitrary input is to weight frequency-wise the system function approximation error. A simple formula is derived for estimating the peak approximation error from the mean square error. Next, the minimization problem is stated and solved for non-orthogonal approximating functions and an arbitrary input. Constrained approximations are implemented by introduction of Lagrange multipliers and constrained approximating functions. Approximation by orthonormal approximating functions has advantages in certain cases, and methods for orthogonalizing approximating functions are presented. A particularly simple orthogonalization procedure, which makes use of a residue condition, is valid when the approximating functions have rational Laplace transforms. The orthonormal functions produced are more general than those previously known. Finally, factors which influence the choice of approximating functions, i.e. the choice of the poles of the approximate system function, are described. Although an

optimum choice of approximating functions is not feasible, several usable alternatives are proposed.

Part Two, which applies the basic theory to practical synthesis problems, considers separately the impulse response approximation problem and the arbitrary input problem. Analytic procedures are proposed which are applicable when the prescribed response has a known Laplace transform and the approximating functions have rational Laplace transforms. When the prescribed input is arbitrary, solution is achieved by means of a related exponential input problem. Tables of inverse matrices, useful in analytic approximation procedures, are tabulated for various families of approximating functions. To ease calculations and include a wider class of prescribed responses, an analog computation scheme based on a physical realization of the approximate linear system is developed. In conjunction with this application, differential analyzer circuits are given for the realization of orthonormal system functions. Simple changes in circuit components allow the poles of these functions to be changed at will. It is shown through theory and examples that reasonable computer accuracy produces satisfactory mean square error approximations. Lastly, methods are described for the experimental determination of unknown physical system characteristics and for the measurement of auto- and cross-correlation functions.

162 pages. $2.15.

ANALYSIS OF THE BLOCKING OSCILLATOR CIRCUIT UTILIZING TRANSMISSION LINE CHARACTERISTICS OF THE PULSE TRANSFORMER

(L. C. Card No. Mic 58-944)

Joseph S. Lambert, Ph.D.
University of Michigan, 1957

The purpose of this study is to present a general approach to the analysis of the blocking oscillator. No straightforward solution of this circuit has yet been given. The highly non-linear operation of the tube has been generally advanced as the difficulty in making a more accurate analysis.

Preliminary investigation pointed to the pulse transformer as the element whose role in the circuit did not appear understood. Since the pulse transformer theory did not appear well developed, this investigation was first centered on the analysis of pulse transformers. A number of such transformers were wound and rewound. Extensive tests were made on these. During the measurement of the pulse transformer parameters certain inconsistencies were noted. In the investigation of these inconsistencies it was found that a pulse transformer under certain conditions, such as it encounters in the blocking oscillator circuit, will act as a short transmission line. This effect is superimposed on the regular transformer effect. Tests made on similar commercially available transformers showed similar behavior. The summary of this investigation is attached as Appendix 2.

The average plate and grid characteristics of the 6SN7 for very positive grid voltages were measured and plotted. These, together with the method of measurement, are given in Appendix 1.

Once the preliminary work was completed an equivalent circuit for the conventional blocking oscillator was assumed. Using this circuit the pulse rise, top, and fall were analyzed and these analyses are presented in the body of the study. Methods are suggested for the solution of these three modes of operation. Detailed sample calculations are given for each of the modes. The path of operation of the blocking oscillator is also derived.

The theory appears to explain the complete operation of the blocking oscillator. Extensive tests were made to confirm the validity of the analysis. The theoretical data are in excellent agreement with the experimental results. No deviation from the proposed theory was found, and the differences between calculated and observed values are minor and readily accounted for. A number of pictures of the more significant oscilloscope traces are included to show the experimental results obtained.

It is concluded that using the average plate and grid characteristics of the tube, the transmission line and transformer effects of the pulse transformer, and not too elaborate calculations, it is possible to calculate the pulse rise time, the pulse top duration, the pulse fall and recovery voltages, and other such factors of the blocking oscillator with a good degree of accuracy. The results depend on how closely the average tube and transformer characteristics represent the particular blocking oscillator and the accuracy with which the calculations are carried out.

Only the conventional type of blocking oscillator is analyzed. It is readily evident, however, that the same method of analysis can be extended to any of the variants of the conventional blocking oscillator. Although the analysis of such circuits was not attempted, several experimental results are included to show that a similar approach is applicable.

231 pages. $3.00.

AN INVESTIGATION OF THE INFLUENCE OF NON-LINEAR TRANSFER FUNCTION ON CATHODE-RAY TUBE VISUAL DETECTION THRESHOLD

(L. C. Card No. Mic 58-1369)

Carl William Miller, Ph.D.
Cornell University, 1958

An experimental investigation was made of the effect of varying transfer function on visual detection threshold for an intensity modulated Cathode-ray tube. Transfer function is defined here as the relationship of Cathode-ray tube brightness to intensity grid voltage.

It was found that certain transfer functions resulted in detection thresholds of more than 6 db below the level obtained with the transfer function encountered in normal operation.

The basic equipment used was a Kay Lab Model 1984A industrial closed-circuit television system, with a 10FP4 type Cathode-ray tube (CRT). The tube was masked to provide a five inch viewing screen. Target size was 3/4 X 3/4 inches on this screen. Noise input to the system was a constant 2.0 millivolts rms of 5.0 mc/S bandwidth and of White Gaussian amplitude distribution. Background (noise plus raster) brightness was constant at 3.0 ft-L.

Conventional intensity modulated CRT's normally have

a transfer function brightness proportional to the intensity grid voltage raised to the 2.5 power, on the average. By means of diode curve-fitter type of circuitry non-linear transfer functions were obtained which in cascade with the 2.5 power law transfer function of the CRT, furnished overall power law exponents (gammas) of 0.8, 1.0, 1.76, 3.4 and 4.6.

The psychophysical method used was the method of adjustment. Five observers (O's) participated. Each of the observers was presented with the five gammas in random order, then the process was repeated. Sixteen responses per O were obtained for each gamma. With constant noise input to the system, O adjusted his target brightness to bare minimum detection for each condition.

Non parametric (Wilcoxon's method) statistical methods were used for data analysis. The lowest detection threshold obtained was with a gamma of 0.8, a "root" type of function.

The results obtained with the industrial television system are directly applicable to industrial television usage. In addition it is expected that the results are applicable to more or less degree in many types of radar systems. Further experimentation is recommended to apply the technique to specific radar systems. 69 pages. $2.00.

A NARROW BAND SPEECH TRANSMISSION SYSTEM

(L. C. Card No. Mic 58-1000)

Doddaballapur Lakshminaranaiah Subrahmanyam, Ph.D.
University of Michigan, 1957

A Narrow Band Speech Transmission System, which scans the time-frequency plane of the signal either in a sinusoidal or a sawtooth manner, has been developed. A scanning signal, which is either sinusoidal or sawtooth, varies a carrier oscillator frequency. The speech signal amplitude modulates the carrier oscillator in a balanced modulator. The lower sideband of the modulator output is selected by a narrow band filter for transmission over a communication channel. These processes form the analysis of the speech signal. At the receiver, a balanced demodulator using a variable frequency carrier, which is synchronized with the scanning carrier oscillator at the analyzer, reconstructs the scanned portion of the original speech signal.

The scanning process leaves empty spaces in the time frequency plane and a multi-channel time-delay system is used to fill in the empty spaces by repeating the signal that has occurred at preceding instants.

The multi-channel time-delay system employed makes use of an electrostatic method of recording and reproducing. An electric charge, which is proportional to an applied voltage, is stored on the surface of a moving dielectric medium. This stored charge, at a later instant of time, induces in a capacitance coupled probe a voltage proportional to the charge. The frequency response of the electrostatic recorder, with a high frequency compensation is flat from 100 to 7000 cps. The response is 3 db down at 70 cps and at 10,000 cps. The signal-to-noise ratio of the recorder is 47 db, and the recorder is linear throughout this range.

The intelligibility of the narrow band speech transmission system has been investigated for 500 cps and 1000 cps bandwidth filters at various scanning rates. Approximately 70 per cent intelligibility has been obtained on monosyllabic words with a filter of 1000 cps bandwidth and a sinusoidal scanning rate of 30 times per second. This intelligibility score is about 160 per cent greater than that of an equivalent filter located in the frequency region of maximum intelligibility.

The system represents a channel capacity reduction in speech transmission by a factor of seven; that is, over a 7000 cps channel it would be possible to transmit approximately seven messages, with each message having an intelligibility of approximately 70 per cent on monosyllabic word lists. 122 pages. $2.00.

A STATISTICAL STUDY OF TRANSISTOR HIGH-FREQUENCY EQUIVALENT CIRCUITS

(L. C. Card No. Mic 58-1306)

Robert Lynn Walker, Ph.D.
Stanford University, 1958

This report describes an experiment performed under statistically significant numbers of transistors. The purpose of the study was to evaluate the efficacies of a number of high-frequency equivalent circuits by comparing directly for each individual transistor the numerical values of selected quadripole parameters obtained (1) by measurement and (2) by means of the equivalent circuits under scrutiny. For a group of 93 alloy-junction germanium transistors (2N123) and a group of 47 surface-barrier germanium units (SB-100) the percent error was obtained for high-frequency values of common-base G_{11}, $|Y_{12}|$, $|Y_{21}|$, and G_{22} derived from the equivalent circuit, compared with values determined by direct bridge measurement. The means, standard deviations, and forms of distribution of these percent errors were studied.

The study revealed that a simple equivalent circuit coupled with an only moderately complex rational approximation for the frequency dependence of alpha suffices to give about 10 percent errors in the prediction of the four high-frequency factors listed above. A simpler and more commonly used alpha expression results in errors of about 25 percent. On the other hand, more sophisticated expressions offer no improvement in results.

The conclusion is reached that a simple equivalent circuit can serve as a valuable link between transistor device parameters and the quadripole parameters often sought by circuit designers. It has been demonstrated that it is feasible to characterize a group of transistors by means of a set of mean device parameter values, although the study has also shown that the variability of the device parameters and the quadripole parameters is such that to include 95 percent of all transistors in a group the range of parameters is usually three to one.

New methods for the determination of the base spreading resistance r'_b, the collector depletion layer capacitance C_c, and the alpha generator cut-off frequency f_α have been developed in the course of the measurements upon which the main study was based. 92 pages. $2.00.

The items following each abstract are: the number of manuscript pages in the dissertation, its cost on microfilm, and the Library of Congress card number. Enlargements 5-1/2 x 8-1/2 inches, 4 cents per page. No postage is charged if check or money order accompanies order.

ENGINEERING, MECHANICAL

AN EXPERIMENTAL INVESTIGATION OF THE TURBULENT BOUNDARY LAYER IN SUPERSONIC FLOW AROUND UNYAWED CONES WITH SMALL HEAT TRANSFER AND CORRELATIONS WITH TWO DIMENSIONAL DATA

(L. C. Card No. Mic 58-1108)

Walter Samuel Bradfield, Ph.D.
University of Minnesota, 1957

Experimental work in the turbulent boundary layer in essentially adiabatic flow at supersonic speeds may be loosely divided into five main categories. They are, experiments on flat plates; on cones; two-dimensional flows with pressure gradients; three-dimensional flows with pressure gradients; and, flows with surface temperature gradients. The present work concerns itself with the second of these categories; namely, cone flow. The essence of the work is the comparison by suitable engineering relations of cone flow experiments under constant surface temperature and nearly adiabatic flow with corresponding plate flow experiments, both compressible ($1 < M_1 < 5$), and incompressible.

In the pursuit of this end, a new type of total temperature boundary layer probe was designed, developed, and applied to the first measurements of total temperature profiles in the boundary layer of a cone at supersonic speeds; a qualitative, integrated, physical picture of probe-boundary layer interactions was developed; correlations among velocity profiles, total temperature profiles, momentum thickness, displacement thickness, shape parameter and enthalpy increment for plate, cone, and axial flow cylinder were established; and local values of heat transfer and skin friction coefficients were compared with compressible flow and incompressible flow plate values.

The result is that the engineer, knowing an incompressible relation for skin friction, a reference temperature defined by Eckert, the modified Reynolds analogy of Colburn, and the plate-to-cone transformation of the present work can readily predict skin friction and heat transfer values in a turbulent boundary layer on a conical body in flight at zero yaw. 151 pages. $2.00.

VISCOUS FLOW THROUGH SMALL CLEARANCES WITH APPLICATION TO THE PROBLEM OF LEAKAGE IN RECIPROCATING PUMPS

(L. C. Card No. Mic 58-905)

Munir Ridha El-Saden, Ph.D.
University of Michigan, 1957

This dissertation deals with the problem of fluid leakage and its prediction in reciprocating pumps. As a basic and necessary step toward this goal, the problem of the flow of a viscous, incompressible fluid, through small concentric and eccentric annuli between two coaxial cylinders with relative motion was investigated mathematically, and confirmed experimentally.

In the mathematical analysis, the isothermal assumption, whereby the temperature and the viscosity of the flowing fluid are assumed constant, was first employed. Then the work done on the fluid, due to the relative motion, as well as the heat conducted through the boundary were taken into consideration. However, due to a mathematical difficulty in the course of the analysis, the heat conduction term had to be neglected, thereby restricting the analysis to the adiabatic case only. The viscosity was allowed to vary with the temperature only, while the density was assumed constant.

In the experimental work, the clearance consisted of the space between a piston and a cylinder. A pressure difference was maintained across the piston. The motion of the piston was caused by the rotation of a crank. Heat conduction through the cylinder wall was allowed to take place, thereby deviating from truly adiabatic flow.

Tests were run on three lubricating oils. The speed was varied from zero to 1000 rpm. Nitrogen cylinders were used as the source of pressure. They limited the maximum obtainable pressure to 1725 psi.

The mathematical results of the isothermal and the adiabatic cases as well as the experimental results were plotted. The experimental points fell between the isothermal and the adiabatic curves, that is, above the isothermal curve and below the adiabatic curve. In some runs, the temperature rise was 45°F, while the flow rate was more than three times what the isothermal results predicted. These results clearly indicate that the isothermal assumption is not adequate to give the correct rate of flow and temperature rise of the fluid, especially at high relative motion. On the other hand, the adiabatic assumption seems to be reasonably adequate to do this.

From the comparison of the mathematical and the experimental results, it was also concluded that, during operation, the piston remains concentric with respect to the cylinder.

The analysis, based on the adiabatic assumption and the conclusion regarding the concentricity of the piston, was then applied to the actual problem of a reciprocating pump. Results, in the form of equations and graphs, are presented for the prediction of the maximum rate of leakage and the maximum rise in the temperature of the leaking fluid that may be expected in the operation of a reciprocating pump. 113 pages. $2.00.

THERMAL LOADING AND WALL TEMPERATURES AS FUNCTIONS OF PERFORMANCE OF TURBOCHARGED COMPRESSION IGNITION ENGINES

(L. C. Card No. Mic 58-1413)

Naeim Abdou Henein, Ph.D.
University of Michigan, 1957

Turbocharging is one method used to increase the specific power output of the compression ignition engine. The increase in power is limited by the mechanical and thermal loading of the engine and its wall temperatures. This dissertation is concerned with the thermal loading and combustion-chamber wall temperatures of the engine as functions of the principal variables which affect the engine output.

The work includes both theoretical and experimental data. The theoretical part consists of an analysis of the

process of heat transfer from the gas to the cooling medium. The experimental data were obtained from tests made on a four-stroke, single-cylinder Nordberg Diesel Engine having a bore of 4-1/2 inches, a stroke of 5-1/4 inches, and a compression ratio of 14.5.

Air was delivered to the engine from a compressed air source and provision was made for heating the air before its entry into the engine intake manifold. The tests covered the following ranges: manifold absolute pressures up to 45 inches mercury, manifold temperatures up to 204°F, engine speeds from 560 to 1770 R.P.M., and indicated mean effective pressures up to 152 $\frac{\text{lbs.}}{\text{sq.in.}}$. Since the engine was designed to run under naturally aspirated conditions, the exhaust temperature was limited to 1000°F and the gas peak pressure in the cylinder to 1200 $\frac{\text{lbs.}}{\text{sq.in.}}$, to avoid troubles due to overloading by supercharging.

The transient temperature of the combustion chamber wall inner surface was measured by a special high response thermocouple having a theoretical response time of 4.5 microseconds. It is believed that this is the first time these transient temperatures were accurately measured. The gas pressure inside the cylinder was measured by a strain-gage type pick-up and oscilloscope.

The experimental results showed that the thermal efficiency is improved by supercharging, for a given power output, due to increased air-fuel ratio. The heat losses to the cooling water at any intake manifold pressure changes in direct proportion to the indicated mean effective pressure, if the manifold temperature is kept constant. The exhaust gas temperature at constant engine speed is primarily a function of the fuel-air ratio, with minor change due to variation in the manifold pressure and temperature.

The mean coefficient of heat transfer from the gas to the cylinder walls, and the gas mean effective temperature were calculated for many runs with different operating conditions. These were used to derive equations for the combustion chamber wall temperature and the thermal loading in terms of the manifold pressure and temperature, mean piston speed, indicated mean effective pressure, and other constants depending on the cooling mechanism.

The formulae developed were used to predict the merits of aftercooling as a means for increasing the specific power output, and for reducing both the thermal loading and wall temperatures of the engine.

It was concluded that the thermal loading and wall temperatures are primarily functions of the indicated mean effective pressure and are affected to a lesser degree by intake manifold conditions and the engine speed. Higher specific power outputs and lower thermal loadings and wall temperatures can be achieved, at constant fuel-air ratios, by increasing the intake air density while keeping its temperature as low as possible.

Aftercooling permits increasing the air density by decreasing its temperature. The thesis provides quantitative information concerning the relative effects upon the engine, caused by engine inlet air temperature reduction and pressure losses resulting from the use of an aftercooler.

177 pages. $2.35.

EXPERIMENTAL AND ANALYTICAL STUDY OF VISCOUS COMPRESSIBLE FLOW IN A UNIFLOW VORTEX TUBE

(L. C. Card No. Mic 58-951)

Joachim Joseph Ellery Lay, Ph.D.
University of Michigan, 1957

The present investigation is an experimental and analytical study of viscous compressible flow in a uniflow vortex tube. There is need for such a study from the ground up, for to date, no general agreement on the theory of the vortex tube has yet been reached.

The problem is first approached from the experimental standpoint. A large multi-purpose vortex tube is designed and built of lucite. Design features enable traverse measurements of pressure, temperature, and velocity to be taken at six different stations throughout the length of the tube. The pressure and temperature probes are of the hypodermic type with minimum flow disturbance. The velocity probe is a miniature hot wire anemometer which is revolvable for measurement of direction as well as magnitude. Data is taken for five runs of different inlet pressures.

The Analytical approach consists of a mathematical treatment of vorticity in general. It begins with potential vortex flow in the plane. This is characterized by the existence of sonic or limit circles. An axial velocity is then added to yield the solution in space. The effect of viscosity is considered, and the potential or free vortex is shown to change into a forced vortex.

The general solution is arrived at by superposing a viscous compressible sink with the vortex flow. Performance or energy separation is expressed as a function of the ratio between vortex strength and sink strength.

283 pages. $3.65.

HEAT TRANSFER IN THE TURBULENT INCOMPRESSIBLE BOUNDARY LAYER WITH CONSTANT AND VARIABLE WALL TEMPERATURE

(L. C. Card No. Mic 58-1303)

William Craig Reynolds, Ph.D.
Stanford University, 1958

Heat transfer from a flat plate to a turbulent incompressible boundary layer has been investigated both experimentally and analytically. While most such investigations have in the past been confined to situations where the plate temperature is constant, the present work treats the variable temperature case as well. In addition, the effect of the location of transition from a laminar to a turbulent boundary layer on heat transfer to the turbulent layer has been investigated in some detail.

This dissertation is divided into four main parts. Part I treats the case of constant wall temperature, and Part II is concerned with the more complex case of a step plate temperature distribution. In Part III the results of experiments and analyses for the step temperature distribution are extended to the more general arbitrary temperature distribution case. Finally, Part IV presents the results of experiments and analyses for the effect of

transition point location on heat transfer to the turbulent boundary layer.

The heat transfer data presented in Part I extend the range of confirmation of the von Karman heat transfer-momentum transfer analogy (for low Mach numbers) to Reynolds numbers of 3.5×10^6. In addition, velocity and temperature surveys made in the boundary layer indicate that the velocity and temperature profiles are similar; both may be approximated by power formulas, with temperature and velocity both varying about as the 1/5.6 power of the distance from the surface. The survey data are in good agreement with other available data in the Reynolds number range of these tests.

In Part II two analyses are presented for the case of a step wall temperature distribution. The step case is of interest in its own right, and it also forms a basis for treatment of arbitrary wall temperature problems. The first analysis is an integral type, wherein the forms of the velocity and temperature profiles are assumed and the heat transfer rate determined. Temperature surveys taken after a step in the wall temperature indicate that the temperature and velocity profiles are not similar, but the temperature varies about as the 1/7 power of the distance from the surface. Assuming that the velocity and temperature profiles may be approximated by 1/7 power formulae, the resulting integral analysis is in excellent agreement with the heat transfer measurements of Part II. The second analysis is a differential type, wherein the energy differential equation of the boundary layer has been solved exactly for the case of a 1/5.6 power velocity profile. The temperature profiles determined by the differential analysis are in good agreement with the experimental profiles taken after a step in the plate temperature; the heat transfer predictions of the differential analysis are also in reasonable agreement with the heat transfer data.

In Part III the result of the integral step temperature distribution analysis is used as the superposition kernel for the arbitrary wall temperature problem and several examples are worked out in detail. In addition, the inverse problem of arbitrary heat flux has been treated. Approximate methods for numerical calculation of variable wall temperature and heat flux problems are presented and illustrated by examples. The results of several experiments with a non-isothermal flat plate are compared with predictions of non-isothermal theory, and good agreement is found in each case.

Part IV in an analysis of the effect of location of transition on heat transfer to the turbulent boundary layer is presented. The analysis is made assuming an abrupt transition, but may be extended to "natural" transitions with the addition of certain statistical information. The statistical treatment allows prediction of heat transfer in the transition region, as well as the effects of its location and spread, on the heat transfer to the turbulent layer. The abrupt transition analysis is in agreement with the results of a limited experimental investigation, and the natural transition data agree well with the predictions of the statistical analysis. 242 pages. $3.15.

AN EXPERIMENTAL STUDY OF LOCAL CONVECTIVE HEAT TRANSFER AND PRESSURE DROP FOR LAMINAR AND TURBULENT FLOW OF AIR WITHIN A UNIFORMLY PACKED BED OF SPHERES AT THREE DIFFERENT POROSITIES

(L. C. Card No. Mic 58-1143)

Robert Dale Turnacliff, Ph.D.
University of Minnesota, 1957

Adviser: E. R. G. Eckert

An experimental study was made of pressure drop and local convective heat transfer in three uniformly porous beds composed of spherical particles. Uniform rearrangement of the spheres made possible a study of three different porosities: 0.477, 0.395, and 0.259. The Reynolds numbers, based on the particle diameter and the upstream air velocity were varied over a range approximately from 50 to 1000.

A unique experimental system and calculation procedure was developed for the study of the local heat transfer within such uniformly porous beds. The test section was an eight-inch cube of one-half inch diameter spheres; this cube was heated at the top by radiation, insulated around the four sides, and cooled by air flowing up from below. Thermocouples embedded in the spheres along the center line of air flow measured the temperature gradient through the cube; a special design gave high thermal conduction parallel to the air flow. From the measured temperature gradient it was possible to calculate the local convective heat transfer coefficient for each sphere along the centerline of flow.

The local convective heat transfer coefficient is presented in terms of the local Stanton number versus Reynolds number for successive sphere positions beginning with the first sphere at the entrance to the bed and proceeding into the bed to a depth of thirteen particle diameters. The existence of distinctly separate laminar, transition and turbulent flow regimes is apparent from the heat transfer and pressure drop data. A second presentation of test results is made showing the local variation of the Nusselt number with sphere position in each bed for various Reynolds numbers.

The pressure drop results are interpreted in terms of a modified Fanning friction factor versus Reynolds number for each of the three beds investigated.

A presentation is also made of the experimentally determined local temperature of the solid and the fluid within each bed for a number of different Reynolds numbers. Since the experimental system and conditions represent an enlargement of a porous medium used in transpiration cooling where a constant heat flux is applied to one surface, these temperature gradients are of particular interest. As predicted by theory each temperature gradient was nearly exponential. 198 pages. $2.60.

The items following each abstract are: the number of manuscript pages in the dissertation, its cost on microfilm, and the Library of Congress card number. Enlargements 5-1/2 x 8-1/2 inches, 4 cents per page. No postage is charged if check or money order accompanies order.

ENGINEERING MECHANICS

EXTREME-VALUE ANALYSIS OF OSCILLATIONS

(L. C. Card No. Mic 58-1380)

Alfred Randolph Bobrowsky, Ph.D.
University of Michigan, 1957

The primary purpose of this paper is to describe a new analytical technique for investigation of autonomous oscillations (henceforth termed "oscillations") in physical systems where forces act on one mass whose position can be described by a single coordinate (henceforth termed only "systems"). These systems need not be describable by differential equations of second order, but may even be represented by "rules" which determine (for a force-mass system) the force-displacement relation for each half-cycle of oscillation; such systems may correspond to differential equations of infinite order. A second purpose is to classify systems according to their oscillational behavior.

Oscillations are here described by portrayal of secularly consecutive extreme displacements on a two-dimensional plane termed the extreme-value plane. The rectangular Cartesian coordinates of this plane are given by the right-hand and left-hand extreme displacements, respectively, from an arbitrary origin. A pair of successive extreme displacements defines one point on the extreme-value plane. The loci of such points, for all possible initial displacements, are the extreme-value characteristics of the system. There are always two characteristics for a given system:

1. Left-hand extreme displacement = a function of the right-hand extreme displacement.
2. Right-hand extreme displacement = a function of the left-hand extreme displacement.

If the pair of extreme-value characteristics of a system are known, the displacement history of the system (for any given initial displacement) can be depicted in the extreme-value plane by a trajectory composed of horizontal and vertical straight lines.

This delineation of oscillations by extreme-value characteristics yields the following information for all initial displacements: existence and types of singular points; existence and types of limit cycles; oscillational behavior after finite perturbation from a stationary state; evidence of self-intersection of phase-plane trajectories for a class of systems in which self-intersection occurs (phase plane here defined as positional coordinate—momentum plane); and presence of skip-oscillations (points at which velocity vanishes, but whose preceding and succeeding velocity are of same sense). In addition, the following possible properties of oscillational systems, which have been little considered previously, are set forth: stationary states such that successive extreme displacements after an infinitesimal perturbation are definitely not monotonic; boundaries on extreme displacements of oscillation, said boundaries not being limit cycles or singular points; and stationary states that require description of more than one cycle of oscillation for complete definition. These properties make possible extensions of definitions of limit cycle and stability.

Applications of extreme-value analysis are made to the following examples: linear harmonic oscillator with various degrees of damping; wire carrying a current in a magnetic field and restrained by springs, for several values of current; elastic vibrations of a column including instability and damping; clocks with constant friction and energy impulse each half-cycle, energy impulse every other half-cycle, two consecutive energy impulses (at the point of zero velocity or when mass passes origin) every four half-cycles, and energy impulse every four half-cycles; and crankless internal-combustion machine with gas springs.

It is concluded that extreme-value analysis is suitable for use with any oscillations problem which can be treated on the phase plane as well as with other problems in which successive extreme displacements can be found.

226 pages. $2.95.

NONLINEAR VIBRATION PROBLEMS TREATED BY EXTENSIONS OF THE RITZ AVERAGING METHOD

(L. C. Card No. Mic 58-1281)

Phil Ross Cobb, Ph.D.
Stanford University, 1958

In solving nonlinear vibration problems by the conventional Ritz averaging method, the approximating function is generally chosen as a polynomial composed of products of coefficients (open parameters) and coordinate functions. In certain types of problems it is felt that the approximate solution can be greatly improved by an extension of the conventional averaging method and a more judicious choice of approximating function. This dissertation treats two such extensions and their application to two specific types of problems.

Part I concerns itself with the increase in accuracy over the conventional method by the choice of a more "flexible" approximating function with the same number of terms. This flexibility is accomplished by the addition of open parameters within the coordinate functions. These extra parameters result in each term containing more than one open parameter and the approximating function will have the form $\tilde{q} = \sum_{i=1}^{m} \tilde{q}_i(\gamma_{i1}, \gamma_{i2}, \cdots \gamma_{in}, \tau)$. The use of such an approximating function requires a new formulation of the averaging method.

Part II examines a group of problems for which there is energy stored or exchanged at the boundaries of the system. For this group the averaging method is formulated with special emphasis on the terms that arise as integrated parts. Also a discussion of the selection and use of the approximating functions is necessary.

The method of attack for both types of problems is the same. This is the Ritz procedure where the approximating function is substituted into the appropriate integral and this integral is minimized with respect to the open parameters of the approximating function. The resulting equations determine the unknown parameters.

The examples in Part I involve differential equations that describe the free and forced vibration of mechanical systems which have restoring forces that are a function of pure powers or of polynomials of the displacement. These problems have previously been solved assuming a single term sine function. The solution for the extended method

is carried out for an assumed single term, "parabolic" function of the form $\tilde{q} = \frac{Q}{\alpha - 1}(\alpha\tau - \tau^{\alpha})$ where Q and α are the open parameters. The flexibility of this approximating function allows a better approximation of the actual $q - \tau$ relationship and therefore yields less error in the solutions (such as in the determination of the frequency-maximum displacement relationship). For the differential equation $\ddot{q} + \kappa^2 \mu_7 q^7 = 0$ the frequency-maximum displacement relationship as determined by the single term, sinusoidal approximation is 20% in error while the "parabolic" approximation is less than 1.5% in error. Curves are presented showing a comparison of the resulting $q - \tau$ relationships for two examples.

As examples for Part II the problem of the taut wire forced laterally at one end is solved. The linear system is treated for both a periodic force and a periodic displacement at the end. These two problems serve as a demonstration of the method. Later, the system is treated as a nonlinear problem by consideration of additional curvature effects. The solution of this problem consists of solving for the steady state vibration mode as a function of the forcing frequency. Also there is a discussion of the significance of the integrated parts which represent the "end point" or boundary values. 81 pages. $2.00.

AN IMPROVED THEORY OF PLATES OF VARIABLE THICKNESS

(L. C. Card No. Mic 58-908)

Franklin Essenburg, Jr., Ph.D.
University of Michigan, 1957

This investigation is concerned with the development of an improved theory for plates of variable thickness. In the classical treatment of non-uniform plates, the stress strain (or stress displacement) relations appropriate for uniform plates (which do not account for the effect of transverse shear deformation and transverse normal stress) are substituted into the integrated (across the thickness of the plate) differential equations of equilibrium, and only after this substitution is the rigidity treated as a function of the coordinates. Moreover, the classical formulation and the solutions arising from the associated boundary value problems do not conform to the prescribed surface tractions at the top and bottom surfaces of the plate. In order to obtain an improved theory for plates of variable thickness, it is necessary not only to account for the effect of transverse shear deformation and transverse normal stress, but also, at least in principle, to satisfy exactly the requirements for the surface tractions at the top and bottom surfaces and to derive suitable stress strain relations which are entirely consistent with the remainder of the theory.

In the present development, a set of "approximate" stress strain relations which conform to all the requirements stated above, together with the appropriate boundary conditions of the problem, are derived and are employed in deducing a system of differential equations governing the displacements of the plate, which accounts for the effects of thickness variation, transverse normal stress, and transverse shear deformation. These equations contain terms in which the effect of thickness variation is coupled with the effect of transverse shear deformation. This coupling, which gives rise to considerable intricacy in the differential equations, may, when neglected, be the source of substantial error.

In order to illustrate the significance of the improved theory, solutions are given for a class of axisymmetrically loaded circular plates, which involve elementary as well as hypergeometric functions. In addition, a problem in rectangular coordinates is solved and the application of the theory to other more complicated problems is discussed. Specifically, graphs showing the comparison of the numerical results with the predictions of the classical theory clearly point up the relative importance of the inclusion of the effects of transverse shear deformation, transverse normal stress and thickness variation. 98 pages. $2.00.

THE PLASTIC RESPONSE OF BEAMS TO IMPACT LOADING

(L. C. Card No. Mic 58-1284)

Arthur Abraham Hyam Ezra, Ph.D.
Stanford University, 1958

A study is made of the plastic response of a simply supported beam to an impact load delivered at mid-span by a falling striker. The deflection and rotation at mid-span are used to measure the plastic response. The elastic strain energy due to bending that the beam can store is small compared to the kinetic energy of impact, and the elastic response is neglected. The material of the beam, mild structural steel, is considered rigid wherever the bending moment is less than the plastic yield moment. High rates of strain make the yield moment higher than the static yield moment. This important factor is included in the analysis.

The commonly accepted idealization of the behavior of the beam under an impact load at mid-span pictures the beam as folding in two halves about a plastic hinge at the center. A mathematical model of this kind will not correspond to the initial condition when the striker first touches the beam. At this instant, the cross section at the common point of contact alone has a velocity v, while the remainder of the beam is at rest.

During a small but finite interval of time called the first stage of impact, starting with the initial condition, the central cross section is decelerated while the remainder of the beam is accelerated. This continues until the distribution of velocities corresponds to that given by the two halves of the beam folding about a plastic hinge at the middle, which constitutes the second stage of impact. This lasts until motion ceases. Using energy considerations one can readily calculate the deflection and rotation at mid-span during the second stage.

The motion of the beam during the first stage is represented by a mathematical model based on the following idealization. A V-shaped kink forms symmetrically about the center. Beginning with a zero width it increases in size until the end of the first stage. A stationary plastic hinge due to positive moment exists at the center and two moving plastic hinges caused by negative moment form the shoulders of the V. From this mathematical model, three differential equations of motion are derived.

As a first step towards solving these equations, they are reduced to two approximate equations, good for a small fraction of the first stage, and starting with the initial condition. These approximate equations have a simple closed form solution. The results they give agree very well with experimental results by other investigators who were able to measure rotations at mid-span a fraction of a millisecond after the initial condition.

For small ratios β of half mass of beam to mass of striker, the relative duration of the first stage of impact is small. When computing total plastic deformations, the error will not be appreciable if the first stage is omitted from consideration, or the solution of the approximate equations is used for the entire first stage. Experiments were performed for small β values, and good agreement was obtained between theory and observations of deflection and rotation at mid-span.

For increasing values of β, the relative duration and importance of the first stage increases. The results will be less satisfactory if the first stage is omitted. For moderate β values, it will still be satisfactory to use the solution of the approximate equations for the entire first stage.

For large β values, the three original differential equations have to be solved. Even though an analytic solution was found, it was not in closed form, and required so much labor to yield numerical results that a direct numerical integration of the differential equations was far more advantageous. 97 pages. $2.00.

STABILITY OF FORCED VIBRATIONS IN NONLINEAR SYSTEMS WITH TWO DEGREES OF FREEDOM

(L. C. Card No. Mic 58-1285)

Donald Lawrence Farr, Ph.D.
Stanford University, 1958

This investigation examines the stability of the steady state motion of a two degree of freedom mechanical model, which is excited sinusoidally. The model consists of two springs and two masses arranged in series with the first spring attached to a fixed foundation and with the exciting force acting on the first mass. In the various examples treated, either one or both springs contain nonlinearity of the cubic type.

A small disturbance is added to the steady state motion and the resulting expression is introduced into the equation of motion. In this manner a new set of differential equations is obtained which determine the variation of the resulting motion from the original steady state motion. If all of the solutions of this resulting set of equations are bounded in time, the steady state motion is said to be stable; otherwise, it is said to be unstable. An approximate solution of one term is used to describe the motion, and hence only the stability of this one term is determined.

The responses of the systems are shown in response planes which give the absolute values of the amplitudes of steady state motions as a function of the square of the normalized driving force frequency. These response planes are divided into regions of stable and unstable motion. For all the examples treated, the first approximations to the curves dividing the response planes into stable and unstable regions are the curves determined by the amplitudes of free vibrations and the curves determining the loci of vertical tangents for the forced responses. For each system the stability results are shown in two separate response planes, one for the first mass and one for the second mass. Each unstable region lies between a free vibration curve and a locus of vertical tangents both of which originate from the same point on the frequency axis. Each set of these curves originates from the frequency axis at a natural frequency of the linearized system. The first approximations used in determining the stability regions give reasonable results even for large nonlinearity, except in the region near the higher natural frequency of the linearized systems for examples in which the second spring is nonlinear. The approximations used are such that the regions of instability converge to the exact regions as the nonlinearity becomes small.
120 pages. $2.00.

NONLINEAR PROBLEMS OF ONE-DIMENSIONAL WAVE PROPAGATION IN GASES (TREATED BY THE RITZ METHOD)

(L. C. Card No. Mic 58-1286)

Ian Millar Fyfe, Ph.D.
Stanford University, 1958

The Ritz Method has been used extensively in solving statical and vibration problems. In this dissertation the feasibility is investigated of applying the Ritz Method to wave propagation problems involving one space in addition to the time coordinate.

The Ritz Method is a direct method in calculus of variations. An approximate solution is found by minimizing the calculus of variations integral, with respect to a finite number of unknown parameters in the assumed form of solution. In order that the Ritz Method can be applied it is necessary to obtain a functional in that integral which fully describes the problem, and if possible contains only one dependent variable. The bulk of this dissertation is concerned with the two problems of (a) obtaining that functional and (b) of selecting the appropriate assumed form of the solution.

The problem of a plane wave propagating in a gas column within the length of a finite tube closed at one end with a piston oscillating at the other is treated as an example (using the Eulerian as opposed to the Lagrangian viewpoint). A series solution is assumed for the velocity potential and the unknown coefficients are found by means of the Ritz Method. The results from a four term series are compared with experimental evidence.

Symmetrical spherical wave propagation falls into the category of problems involving one space coordinate only. The functional is found in a form suitable for applying the Ritz Method to solve such problems.

Consideration is also given to the Lagrangian viewpoint, and the functional is found for plane wave propagation, by using Hamilton's principle. 73 pages. $2.00.

A STUDY OF THE COMPLETE SOLUTION OF THREE-DIMENSIONAL PHOTOELASTICITY PROBLEMS BY INTERFEROMETRY

(Publication No. 25,265)

Daniel Post, Ph.D.
University of Illinois, 1957

The thesis is divided into three interdependent parts. In the first, the theory and techniques are developed for a new photoelastic method for three-dimensional stress analysis. By this method, small cubes, dissected from a frozen stress model, are viewed in an optical interferometer with incidence in three mutually perpendicular directions. The birefringence associated with the state of stress at the location of the cube gives rise to two optical path lengths for each direction of incidence. Thus, six path lengths, or absolute retardations, are measured for a given cube. These six measurements provide sufficient information for the complete stress solution of the point under consideration.

Accordingly, the method permits complete analysis of stresses at an arbitrary point in a photoelastic model by measurements for that point alone. The method involves only well established relationships of photoelasticity and optics, and its validity cannot reasonably be doubted. The system developed for interferometric measurements is reasonably simple, rapid and accurate. Labor involved compares favorably with the three-dimensional shear difference method for interior stress analysis. The method is not subject to a limitation of the shear difference method, in which the analysis must commence at a point of known stress, and any static elasticity problem can be solved by the absolute retardation method.

Results of an experimental analysis by the absolute retardation method were unsatisfactory, but this was attributed to limitations of the photoelastic model material, rather than the method. Future studies in material properties will be required to make the method practicable.

Part II deals with the photoelastic calibration of vitreous silica. This material is of interest because a preliminary examination seemed to indicate a large deviation from Pockel's Law—that changes of refractive index are a function of volume change, and are independent of the origin of such volume changes, be it thermal, mechanical, electrical, or radiation effects. Since changes of refractive index (or optical path length) associated with any system of mechanical forces can be predicted by the Stress-Optical Law of photoelasticity, the relationship between refractive index and mechanical forces could be fully established by a determination of the photoelastic material constants. Thus, this aspect of Pockel's Law could be studied by photoelastic techniques.

A compression member was chosen for the calibration specimen. The compressive load was applied and measured by a specially designed load dynamometer, and absolute retardations were measured by application of a parallel-mirror Series Interferometer. Relative retardation measurements were made with the aid of the method of photoelastic fringe multiplication of 9x and 7x.

Two vitreous silica specimens of different origin were studied. Photoelastic constants for the two materials were the same within experimental error. The specimens exhibited moderate dispersion of photoelastic constants in the wavelength range 4358 - λ5780. Probable error in the determinations of absolute retardation constants C_2 and C_1 was assessed as 1.4% and 4.0% respectively, and for the relative retardation constant C_σ, 1.1%. The change of refractive index that would be developed by hydrostatic compressive loading can be calculated to an accuracy of 2.5%.

Part III is devoted to an analysis of the multiple-beam fringe sharpening phenomenon developed in the Series Interferometer, the major element of experimental apparatus employed in Parts I and II. Intensity contributions developed by successive reflections at the mirrors of the interferometer yield a sharply peaked intensity-fringe order relationship, wherein very narrow fringes appear upon a dark background. An exact formulation appears to be prohibitive, but a formulation which accounts for all significant contributions yields a solution that is believed to predict the intensity distribution of these fringes with substantial accuracy. 127 pages. $2.00. Mic 58-1823

THERMAL STRESS IN ELASTIC PLATES INCLUDING SHEAR DEFORMATION

(L. C. Card No. Mic 58-981)

John C. Rowley, Ph.D.
University of Michigan, 1957

The purpose of this investigation is to study the thermal stresses in plates in which the influence of transverse shear deformation is included. The variational theorem of E. Reissner is utilized to derive the general equations for plates which are subjected to temperature differences across the thickness of the plate.

Two general classes of plate problems are examined to evaluate the effect of the shear deformation on the state of stress. In the first case the plate is free to deflect. From a consideration of the infinite plate it is demonstrated that the effect of the shear deformation is a boundary layer phenomenon; that is, this correction to the classical plate theory is important only within a small region, a few plate thicknesses in width, near the edges of the plate. To probe this conclusion further the example of the semiinfinite plate is treated; and it is observed that in this boundary region the shear correction will have a substantial influence on the state of stress, compared to the corresponding classical solution, if the change in the thermal gradient is steep relative to the plate thickness. The second class of problems considers a plate that is restricted from deflecting due to overlaying rigid planes. Here it is disclosed that stresses in addition to those calculated by the classical equations may be evaluated, and that this shear correction is not a boundary layer phenomenon, but is significant wherever the thermal gradient varies rapidly.

The method of solution of the boundary value problems posed in this study is the application of the exponential Fourier transform. This technique of solution is used, as it allows results to be obtained in integral form. This closed form is of particular advantage in the study of the qualitative as well as the quantitative behavior of the dependent variables. 130 pages. $2.00.

A STUDY OF THE SWIRL VELOCITY AND THE STABILITY OF LAMINAR SWIRLING PIPE FLOW

(L. C. Card No. Mic 58-995)

Hadley James Smith, Ph.D.
University of Michigan, 1957

The rotational component of velocity (swirl) and the stability of a steady, rotationally symmetric flow in a round pipe are studied analytically and experimentally. The flowing fluid is considered to be incompressible and viscous, and the assumptions of large Reynolds number in the laminar range and small swirl are used in linearizing the equations of motion.

If the upstream axial boundary condition on the swirl is arbitrary, solutions for the swirl include an expansion of orthogonal eigenfunctions which contain a form of the confluent hypergeometric function and which individually satisfy radial boundary conditions of the homogeneous Dirichlet type. The eigenfunction expansion has a suitable convergence for a broad range of axial boundary conditions, including an upstream radial distribution which is discontinuous at the wall of the pipe.

A particular case is considered in which an upstream boundary condition consisting of a prescribed swirl with a radial discontinuity is followed, respectively, by an axial region of growing swirl and one of decaying swirl. A solution for the swirl is compared with data obtained from tests designed to approximate as closely as practicable the conditions assumed for the theory. At large radii, calculated values of the swirl rapidly approach the results of the experiments as the parameters approach the values assumed in linearizing. The solution is found to be useful at moderately large swirl. A new approximate solution, in which the swirl eigenfunctions are replaced by Bessel functions, is compared with the test data. It is found to be convenient for estimating the maximum swirl at various axial positions.

The problem of the hydrodynamic stability of laminar swirling pipe flow is formulated by the method of small oscillations as the first step in a preliminary investigation of the self-excitability of initially small, random disturbances. The resulting stability equation contains the laminar swirl solution as a coefficient. A study of the equation indicates that methods of solution, successful in analyzing the stability of Couette flow and some parallel flows, may be effective in the present case. Measured values of the conditions corresponding to the onset of visible instability indicate that self-excitation, if it occurs, takes place for parametric values bordering those for which the laminar swirl solution is most nearly accurate. The observed instability occurs in the region of axially decaying swirl.

104 pages. $2.00.

ENGINEERING, METALLURGY

THERMAL FATIGUE OF DUCTILE MATERIALS

(L. C. Card No. Mic 58-1385)

Francis Jacob Clauss, Ph.D.
University of Michigan, 1957

Thermal fatigue is the process by which a material ultimately fractures after being repeatedly heated and cooled without being allowed to expand and contract freely. Though thermal fatigue failures are by no means a new problem, the trends in modern technology to higher temperatures and cyclic operations have increased their occurrence and damaging effects.

This dissertation presents the results of a program of fundamental research on the thermal fatigue process in ductile alloys. Cylindrical specimens were heated and cooled through various temperature cycles while constrained from expanding and contracting freely along their axes. Two materials, S-816 and Inconel 550, were studied.

A number of specimens were cycled until they fractured across their test sections, and other specimens were removed from thermal cycling prior to fracture and then tested in stress-rupture. A few specimens were first exposed for varying times under stress-rupture conditions and they cycled to failure in thermal fatigue. Hardness measurements and microscopic examinations were made to follow the process metallurgically and help to develop a theory of thermal fatigue.

The following conclusions were drawn for the materials and test conditions studied:

1. The maximum cycle temperature had more effect than the temperature difference on the number of cycles to failure.

2. Increasing the time of exposure at high maximum cycle temperatures increased the number of cycles to failure, whereas the same increase in time at low maximum cycle temperatures decreased the number of cycles to failure.

3. The number of cycles to failure could not be directly related to the cyclic plastic strain (i.e., to the amount of thermal strain absorbed by plastic deformation during each heating and cooling).

4. Exposure to thermal fatigue conditions strengthened one alloy (S-816) and weakened the other (Inconel 550). Under the most damaging conditions studied, Inconel 550 lost 98 percent of its original stress-rupture life as a result of prior thermal fatigue, even though the number of cycles was only one-half of that required for failure by thermal fatigue alone.

5. A theory has been tentatively proposed that divides the process of thermal fatigue into 2 stages: (1) First, a stage of strain- and/or precipitation-hardening, during which the ductility is reduced and the strength is increased; (2) Second, a stage of the destruction of the cohesive bonds and the development and propagation of cracks. Structural changes that occur during thermal fatigue are an important part of this theory.

131 pages. $2.00.

A STUDY OF THE ROLE OF CARBON IN TEMPER-EMBRITTLEMENT AND THE EFFECT OF TEMPER-EMBRITTLEMENT ON THE FATIGUE PROPERTIES OF A 3140 STEEL

(L. C. Card No. Mic 58-963)

Ernie Bill Mikus, Ph.D.
University of Michigan, 1957

A study of the role of carbon in temper-embrittlement and the effect of temper-embrittlement on the fatigue properties of an SAE 3140 steel was made.

The size, shape, and distribution of carbon and carbides was followed using optical and electron microscopy in conjunction with a stripping film autoradiographic technique as a function of degree of embrittlement at a temperature of 850°F. Radioactive carbon-14 was employed as a radioactive tracer in the steel. Extracts obtained from tough and temper-embrittled structures were analyzed using X-ray and spectrographic techniques. Electron micrographs and autoradiographs of tough and temper-embrittled structures did not reveal the presence of a continuous film, precipitate of carbides, or carbon segregation to the prior austenite grain boundaries as agents for causing temper-embrittlement.

The tensile properties for tough and temper-embrittled structures were also compared. The brittle structures exhibited a greater drop in the beam at the yield point than the tough structures.

A critical analysis of the proposed mechanisms for temper-embrittlement was made and none was found adequate. Based on the results of this investigation and available data an alternative hypothesis for temper-embrittlement was advanced which involves the concept of a strained prior austenite grain boundary caused by a contraction of the ferrite lattice during exposure at the embrittling temperature as a result of a reaction between the existing carbides and the dissolved alloying elements in the ferrite matrix.

The fatigue properties of a tough and severely temper-embrittled structure of an SAE 3140 steel were investigated at 0°F with about 80 R. R. Moore fatigue specimens. Emphasis was placed on establishing the susceptibility of these structures to damage by short periods of initial prestress followed by a runout stress of 75,000 psi, but the fatigue properties of these two structures were also compared in the finite region of the S-N curve. A statistical approach was used in comparing the data.

The results indicated that a severe degree of temper-embrittlement did not affect the fatigue properties of this steel in the absence of a prestress. However, a severely embrittled structure was found to be more prone to damage by short periods of overstress than a tough structure at prestress levels considerably above the runout stress employed. Both structures exhibited a tendency to be strengthened by a prestress level of 80,000 psi. The brittle structure also exhibited less scatter in the individual test points than the tough structure.

151 pages. $2.00.

GRAIN BOUNDARY AND LATTICE SELF-DIFFUSION OF NICKEL

(L. C. Card No. Mic 58-1009)

William Reid Upthegrove, Ph.D.
University of Michigan, 1957

The self-diffusion of nickel in the lattice and along the grain boundaries of nickel was studied in this research. The effects of three variables, time, temperature, and crystallographic misfit of the adjoining grain were investigated. In conjunction with these studies, the feasibility of utilizing the measurement techniques of this research to determine surface self-diffusion data was evaluated.

The influence of crystallographic misorientation was investigated by using nickel bicrystals grown from the molten state with a predetermined orientation. These bicrystals were grown by solidification from nickel single crystal seeds which had a common cube axis in the direction of growth and a simple rotational misfit which could be described by the angle between the other cube axes (perpendicular to the growth direction) of the grains of the bicrystal. Crystallographic orientations were determined by x-ray diffraction techniques.

The self-diffusion of nickel into the nickel bicrystals was studied by electroplating radioactive nickel on the bicrystal specimens and then carrying out the diffusion anneals under argon atmosphere. The diffusion samples were sectioned and the depth of lattice and grain boundary penetration of the diffusing radioactive isotope were determined by means of the permeable base stripping film technique of high-resolution autoradiography.

It was found that the experimental techniques of this research were not suitable for surface diffusion measurements.

The lattice self-diffusion coefficient of nickel was determined over a range of temperatures from 850°C (1560°F) to 1100°C (2010°F). This coefficient was correlated with an Arrhenius-type equation from which an activation energy of 65.9 kcal/mole and a frequenty factor of 0.48 cm^2/sec was calculated.

The depth of penetration by the radioactive nickel along a nickel bicrystal grain boundary was found to be dependent on crystallographic misfit across the boundary, with maximum penetration occurring at the angle of maximum misfit, 45°. The penetration data were analyzed using the available mathematical solutions for grain boundary diffusion. These solutions were shown to represent limiting conditions of diffusion which were approached in this research in the specimens of large crystallographic misfit which were diffused at low temperatures. These solutions are increasingly less accurate with increasing diffusion temperatures and decreasing angles of misfit.

The ratio of the grain boundary diffusion coefficient to the lattice diffusion coefficient varied from approximately 10^3 to 10^7 for misfit angles from 5° to 80° and temperatures from 700°C (1290°F) to 1100°C (2010°F). This ratio was found to increase with increasing angle of misfit and decreasing diffusion temperatures. A parameter of the grain boundary self-diffusion coefficient which included the grain boundary width was correlated with temperature by an Arrhenius-type relationship. The activation energy for grain boundary self-diffusion was shown to be 26 ± 1.5 kcal/g mole, independent of misfit angle, for angles greater than 20° and less than 70°. Beyond these

limits it appears to increase rapidly with decreasing misfit to 65.9 kcal/g mole (zero misfit).

The data of this investigation indicate that the effective grain boundary width for which the grain boundary self-diffusion coefficient will be independent of angular misfit is a function of two variables, both dependent on the misfit angle. It has been shown that it is reasonable to expect that these variables are the boundary misfit and boundary interfacial energy. 160 pages. $2.10.

ENGINEERING, SANITARY & MUNICIPAL

STUDIES ON RUM DISTILLERY WASTES IN PUERTO RICO

(L. C. Card No. Mic 58-883)

Nelson Biaggi, Ph.D.
University of Michigan, 1957

It is the objective of this paper, first, to review the studies which have been carried on throughout the world on rum distillery wastes; second, to present a comprehensive analysis of rum wastes and an approach to the disposal problems of the rum distilleries in Puerto Rico; and, third, to indicate the results observed by the author in laboratory scale treatment of rum waste using conventional purification processes. Special emphasis is given to the results observed on anaerobic digestion at mesophilic and thermophilic temperatures, in gas-recirculating digesters, using soil from a "mosto" lagoon as seed.

Data are presented on the volumes and on the pollutional characteristics of the spent-still liquor from several local distilleries, indicating the marked differences observed between the strength of the slop from each plant. An evaluation is made of the efficiency of each operation used in the production of alcohol, in two selected distilleries. The over-all efficiency in one of the distilleries is found to be significantly higher than in the other, indicating the feasibility of substantial reduction in rum waste load by plant process control.

A typical rum waste slop is subjected to conventional physical, chemical and biological treatment processes, confirming the fact that only biological processes are applicable. The activated sludge process is proved to be highly effective in treating a one per cent rum waste dilution in sewage but is found to be unsatisfactory for a 16.7 per cent waste dilution in water. Batch anaerobic digestion of a 16.7 per cent waste dilution in water that is seeded with "mosto" soil, yielded such satisfactory results that it encouraged the author to proceed further with a more detailed study of this process. Certain modifications were considered, including the recirculation of the digester gas back to the bottom of the digester for mixing purposes, controlled temperature studies at 20, 28, 37, 45 and 55° C., and the addition of supplementary minerals and yeast extract. A remarkably high degree of efficiency is observed in the biochemical oxygen demand (B.O.D.) reduction with digestion over a considerable range of temperature, 20 to 55° C. The optimum digestion appears to occur in the vicinity of 28° C. with unsatisfactory results observed at 20° C. The slop appears to be nutritionally balanced as no significant difference in efficiency was observed in the supplemented test runs.

The following general conclusions can be drawn from the study: (1) Substantial reduction in rum waste load is feasible by plant process control, thereby significantly reducing the burden of treatment. (2) The average rum waste in the local distilleries has a 5-day B.O.D. value of around 3150 pounds and a volume of around 9,000 gallons per 1,000 gallons alcohol produced. (3) Only biological processes appear to be applicable for the treatment of rum wastes. (4) The rum wastes are nutritionally balanced for optimum digestion. (5) A mixture of sewage containing one per cent of the spent-still liquor can be treated satisfactorily with the activated sludge process. (6) The soil from a mosto lagoon is a far better seeding material for digestion of rum waste than fresh sewage, digested sewage sludge, fresh horse manure or soured pasteurized milk. (7) The circulation of the digester gas back to the bottom of the digester seems to be partially responsible for the increased anaerobic activity, as observed from the high per cent reductions in B.O.D. (8) Digestion of the slop is optimum at 28° C., yet the satisfactory digestion temperature range covers a region from the mesophilic at 28° C. to the thermophilic at 55° C. Digestion at 20° C. produced unsatisfactory results. 128 pages. $2.00.

ART CRITICS AND CRITICISM IN NINETEENTH CENTURY AMERICA

(L. C. Card No. Mic 58-696)

John Peter Simoni, Ph.D.
The Ohio State University, 1952

The dissertation deals with the history of art criticism in the United States during the second half of the nineteenth century. It is divided into three main parts and a bibliography: first, a view of early art criticism and art critics, from about 1800 to 1850; second, a biographical sketch of William James Stillman (1828-1901), art critic, painter, author, and journalist, with a review of his contribution to art criticism in The Crayon; third, a survey of the contribution to art criticism made by Clarence Chatham Cook (1828-1900), art critic, author, and journalist, with a biographical sketch and a thorough review of his writings on architecture, painting, sculpture, and varied topics influential in the development of art in America; fourth, an extensive annotated bibliography of primary source material related to the problem of the dissertation, including a background survey of art tendencies and activities for the period covered by this research.

Part I, covering research on the general topic of Art Criticism and Critics, discusses the character of the critical writings on art prior to the appearance of the work of Clarence Chatham Cook and William James Stillman in the 1850's; the significance of artistic expression in the cultural growth of the nation, presenting patterns and tendencies in art criticism as expressed essentially in the writings of John Neal, Washington Allston, Horatio Greenough, Henry Theodore Tuckerman, George William Curtis, and Christopher P. Cranch; the rise of interest in the establishment of criteria of art criticism and the contribution of the early writers in Port Folio and other periodicals to the formulation of standards for use in the evaluation of works of art; and the criteria of art criticism as stated by Russell Sturgis, Jr., Christopher P. Cranch, Richard Henri Stoddard, Helen M. Knowlton, and S. G. W. Benjamin, including a survey of the condition of art criticism in America during the second half of the century.

Part II introduces the art critic William James Stillman with a biographical sketch which includes a description of his early interests in painting and literary pursuits in art criticism, as well as a discussion of his philosophy of art, first as influenced by John Ruskin and the Pre-Raphaelites, and second as perceived by him in the development of his later concepts on aesthetic quality in art. The second division of Part II presents The Crayon (1855-1856) as Stillman's distinctive contribution to art criticism in the 1850's, showing him as a pioneer art critic in the interpretation of the visual arts, with an analysis of his experience as a painter and of his concern with principles in art education.

Part III presents another outstanding art critic of the nineteenth century, Clarence Chatham Cook. First, the biographical sketch treats the significant events of his productive career as art critic for the New York Tribune; as a contributor to Horticulturist, New York Quarterly, Putnam's Magazine, Scribner's Monthly, Atlantic Monthly, Century, Galaxy, and other periodicals; and as editor of The New Path (1863-1864) and The Studio (1884-1894). The second division, Clarence Cook on Architecture, includes a survey and discussion of (a) his writings on domestic, religious, and public architecture from the early 1850's to the late 1890's, including his critical reviews on architecture in Philadelphia, New Haven, Boston, and New York; (b) his criticisms of the work of A. J. Downing, P. B. Wight, Calvert Vaux, Leopold Eidlitz, Wrey Mould, George Fuller, James Renwick, Richard Morris Hunt, George F. Babb and Walter Cook, McKim, Mead, and White, and Henry H. Richardson; (c) his critique of the New York Central Park, its general plan, its gates and sculpture; and (d) his writings on interior decoration. The third division of Part III, Clarence Cook on Painting and Sculpture, surveys Cook's most prolific field of writing, that concerned with painting, both American can European. This historical and critical review of his work presents his philosophy of art as expounded in his articles for The New Path, the New York Tribune, The Studio, and other publications. Cook's criterion for the evaluation of painting is also discussed, in which he emphasizes the distinction between the "new school of realism" (American Pre-Raphaelitism) versus the Academy and the exponents of the "ideal" in art. His philosophy and standards of judgment are revealed through critical reviews of modern painting, representing mainly work exhibited at the annual exhibitions of the National Academy of Design; his evaluation of the 1884 Durand-Ruel exhibition of Impressionist paintings representing the work of Monet, Pissarro, Renoir, Degas, Sisley, Seurat, Caillebotte, Madame Morizot, August Flameng, and Guillaumin; other criticisms of the work of Manet, Daumier, Corot, and Millet; and his critiques of institutions, public and private, occupied in pursuits related to the arts, and of certain significant art collections. Characteristic examples of criticisms are given which typify Cook's views toward such American painters as William H. Beard, Albert Bierstadt, George H. Boughton, Samuel Colman, Christopher P. Cranch, Asher B. Durand, Thomas Charles Farrer, Allan Gay, C. C. Griswold, Henry J. Haseltine, Thomas Hicks, William Morris Hunt, Daniel Huntington, George Inness, Eastman Johnson, John F. Kensett, Emmanuel Leutze, Jervis McEntee, Henry Newman, W. T. Richards, Albert Ryder, Elihu Vedder, Worthington Whittredge, and Alexander Wust. His concern with institutions devoted to the arts and art collections is shown through his evaluation of Louis Prang's chromo-lithographs; the National Academy of Design; the Cooper Institute of Design; the Metropolitan Museum of Art, with particular emphasis upon the controversy over Louis P. Di Cesnola's collection of Cypriote antiquities; and the James Jackson Jarves collection of early Italian paintings. The section on sculpture traces briefly Cook's views on sculpture exemplified in the work of Harriet Hosmer, Anne Whitney, Mrs. Ames, Hiram Powers, Quincy

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Ward, and Augustus St. Gaudens. His editorship of The Studio marks the last significant enterprise of his long and productive career as the day-by-day recorder of artistic events.

The annotated bibliography consists principally of primary source material for the period extending approximately from 1800 to 1900. It is organized from data in such monthly and quarterly periodicals as the Aldine, American Architect and Building News, Art Amateur, Californian, Century, Craftsman, Critic, Dial, Galaxy, Harper's Weekly, Horticulturist, Nation, National Quarterly Review, Atlantic Monthly, Old and New, Port Folio, Putnam's Monthly, Scribner's Monthly, Southern Review, The Crayon, The New Path, The Studio, and others. The file of the daily newspaper, the New York Tribune, is one of the major sources explored. Since a published index of the Tribune does not begin until 1875, one was compiled for the years 1860 through 1873. For the years 1852 to 1860 and 1874 to 1882 there is a selected index of the most important items on art. The selection of Clarence Cook and William James Stillman as protagonists in nineteenth century art criticism determined the character of the bibliography, which is a comprehensive survey of their literary contributions. 560 pages. $7.10.

Abstract published by special arrangement with The Ohio State University.

FOOD TECHNOLOGY

A STUDY OF LIPID OXIDATION IN DRY WHOLE MILK

(L. C. Card No. Mic 58-1142)

Charles Maxwell Stine, Ph.D.
University of Minnesota, 1957

The role of high temperature preheating of milk prior to spray drying in increasing the resistance of the dry whole milk to oxidation has been investigated. Previous investigators have demonstrated that the addition of a sulfhydryl group blocking agent to fluid milk resulted in accelerated oxidation of the fat in fluid milk. One would expect that the addition of such blocking agents to milk prior to drying would result in increased oxidation in the dry milk if the sulfhydryl groups function as antioxidants in dry milk as they apparently do in fluid milk. Addition of the sulfhydryl group blocking agents, para-chloromercuribenzoic acid, iodoacetamide, and N-ethylmaleimide to fluid milks of various heat treatments before drying inhibited oxidation normally occurring during the drying process. During storage in air at 37°F. the samples containing these blocking agents generally oxidized to lower levels than did the corresponding controls.

The chelating agent disodium dihydrogen ethylenediaminetetraacetate was of limited value in inhibiting metal-catalyzed oxidation when added to milk prior to spray drying. Due probably to its chelating action, substantial protection of dry whole milk against metal-catalyzed oxidation was obtained by the addition of carboxymethylmercapto succinic acid before drying.

Since oxidation of the fat in milk does occur during spray drying, a study was made of some of the operating variables of the experimental spray dryer to ascertain their effect on the quality of dry whole milk as indicated by flavor and peroxide value. Quality of the powder did not vary with the inlet air temperature of this dryer. The products of combustion of the gas burner when mixed with the drying air did not adversely affect powder quality. The exit air temperature influenced both flavor quality and peroxide value with detrimental effects demonstrated at an exit air temperature of 190°F.

Both copper and iron are known to be catalysts of oxidation in dry whole milk. An investigation was made of the effect of high temperature preheating of fluid milk to see whether or not a heat-induced shift in distribution of these metals occurred. It was found that copper was not significantly affected by this heat treatment. Iron, both natural and artificially added, as a result of such heat treatment was shown to be shifted from the fat globule interface to the plasma in centrifugally separated milk.

140 pages. $2.00.

GEOGRAPHY

THE OAHE UNIT: A PROPOSED IRRIGATION PROJECT IN A SUBHUMID GLACIATED REGION

(Publication No. 25,432)

Robert Manlius Basile, Ph.D.
The Ohio State University, 1953

The Missouri Basin has been an area of recurrent floods and droughts. Throughout its history the people living there have experienced crop losses in some areas because of lack of water, and crop losses and destruction of property in other areas because of floods. Human suffering is inevitable under such conditions. With the signing of the Flood Control Act in 1944, President Roosevelt urged the creation of the Missouri Valley Authority. The development of the Missouri River valley for irrigation, flood control, navigation, power, and recreation was foremost in the mind of the President, no doubt because the

river's tremendous destructive power could be harnessed for the benefit of the whole Missouri Basin. A small but potentially valuable part of this basin is the proposed irrigation project designated as the Oahe Unit.

The Oahe Unit comprises an area of 1,750,000 acres, of which about 750,000 acres are irrigable. It extends from the west side of the James River in South Dakota, westward to Miller, and from a point a few miles south of Aberdeen on the north southward to the vicinity of Forestburg. This portion of the James River basin offers splendid opportunities for irrigation development, water being available from a reservoir to be impounded by the Oahe Dam six miles north of Pierre on the Missouri River and 125 miles to the west of the proposed area to be irrigated.

This dry-farming region and others like it are new fields of endeavor for reclamation by irrigation. There are few dry-farming regions in glaciated areas that have been irrigated, and consequently little data are available on the value of irrigation to agriculture in such subhumid and glaciated regions. The mechanics of water application is also a problem, since glacial terrain is undulating to rolling and even quite flat in certain outwash and lake plain areas. Yields on irrigated land must be higher than on dry lands to compensate for the higher costs attendant to irrigation. Usually irrigation farming connotes intensive farming. Irrigated land generally has a high value per acre as well as a relatively high annual production cost. This is true because ordinarily taxes are higher on irrigated land than on dry land and water charges must be paid annually. Consequently, an intensive type of farming ought to be developed under circumstances consistent with the objective of attaining maximum production per acre. Where land is cheap, more money will be made by growing crops such as wheat by extensive methods and by combining land and labor in such proportions as to get the highest possible returns per man and unit of capital rather than per acre, which is essentially the present practice.

Topographical Features Affecting Agriculture and Irrigation

In general, the land within the Oahe Unit slopes uniformly toward the James River, but owing to the glacial origin of its surface, many depressions (meltwater channels and kettle holes) and some scattered terminal moraine deposits break up the smooth slopes common to the usual irrigation project. It is not to be construed from this that the slopes would not lend themselves to irrigation, for many irregular surfaces can be leveled or graded to facilitate the distribution of water. Most of the fields will necessarily be irregular in shape rather than rectangular because of the rounded character of the terrain, and some parts of it will be divided into comparatively small isolated blocks surrounded by old meltwater channels, or series of kettle holes. This will necessitate the building of expensive aqueducts or inverted syphons to bring water to the high spots on these "islands." Supply ditches will have to be constructed around the slopes, a gradient for the flow of water to the irrigable land always being maintained. It will also require many more miles of construction than would be necessary in alluvial or lacustrine areas. This will make irrigation by the usual methods, such as furrow or corrugation, comparatively expensive.

Climate and its Influence on Agricultural Production

According to the earlier Thornthwaite system of classification of climate, the Oahe area is subhumid microthermal with rainfall deficient in all seasons (CC'd). A detailed climatic study in which a climatic map is presented for each year from 1900 to 1950 inclusive shows that the climates of South Dakota vary considerably from year to year. Every climatic type from arid to humid was experienced within the Oahe area within these 50 years. The average condition, subhumid, is misleading because of this extreme variability of the climate that is actually experienced. The unreliable character of the climate is also characterized by drought periods of varying lengths which are injurious to plants. During the months from April to October inclusive, damaging dry periods varied from 20 to 79 per cent of the growing season.

Thornthwaite's latest method of climatic classification is used to indicate the water storage within the soils of the Oahe area. In about every case there is a water deficiency in the soils early in the growing season. This is reflected in the poor crop yields obtained that season.

Comparisons of corn and wheat yields with average annual precipitation are given and results show that crop yields vary directly with the precipitation received. When precipitation is average or above, a crop is usually assured. But when precipitation is below average, or if there are extended dry periods during the growing season, or if there is insufficient moisture within the soils at the time of planting, the yield will be low.

The climate chart developed in the Thornthwaite climatic classification should be modified and used as a means of indicating the amount of water actually stored in soils so as to have a "running account" of available soil moisture at the time of planting in the spring. Since each soil type varies in water storage capacity, the actual storage capacity would be used in computations rather than the four-inch average used by Thornthwaite. As the point of actual soil moisture deficiency is approached, the calculated amount of water need would be applied to the field. This water need would vary with the crop, its stage of development, and the wind intensity, as well as the soil type. Should there be an unusually dry autumn and spring, irrigation water could be spread over the fields to bring moisture in the soils up to optimum levels during these periods of no demand, thus insuring ideal germinating conditions for the seed in the spring. This is a matter for future research.

It is further indicated that although a deficiency of moisture in the soils of the Oahe area usually exists, the degree of this deficiency varies with the year. For example, it is shown that at Huron the average water deficiency to be expected is four inches. This deficiency increased to 16.0 inches in a dry year, 1936, and was reduced to 1.7 inches in a wet year, 1944. Irrigation water will change this situation because more water can be made available to plants by moistening the soil as needed (artificial precipitation) and thereby make the precipitation curve approach the potential evapotranspiration curve or curve of available moisture on the climate graph. When these two curves are made to coincide, moisture conditions would be at optimum levels for good crop production.

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Natural Resources

South Dakota is primarily an agricultural state and no doubt will continue as such. Its natural resources are few. Its fertile soils and agricultural products of these soils constitute the basis for most of the occupational activities of its citizens. Water has been critically short during some years, with widespread crop failure resulting.

Surface and subsurface water is being utilized to the fullest extent at present. Additional sources of water will be necessary if any sizeable growth of towns and cities is to be experienced in the James Valley. Artesian water flow, once copious, has been greatly reduced, so that the volume of water received is far from adequate for the growing communities. Geologic explorations endeavoring to locate new water supplies in buried glacial outwash and other coarse sands and gravel deposits have been in progress continually.

Aberdeen and Huron in the past obtained water from a series of wells until the yield became inadequate; now they are obtaining water from surface supplies. Both cities have been forced to construct dams to impound river water, and clarifying and purifying that water has involved a considerable expense. As the requirements increased, greater demands were made upon these water supplies. Today there is little reserve capacity available. Further growth of these cities and others in the James Valley will depend upon new sources of water. Waste water from these cities flows to, and is carried away by, the James River. Reducing pollution is a major problem along the water course because river flow fluctuates widely. More water made available by diversion of a part of the Missouri River flow for irrigation and domestic purposes would lessen these difficulties.

The chernozem soils are inherently fertile, but without water they will produce only a meager crop, as is evidenced in the yield data for various crops during the dry years of the 1930's. There are restricted areas such as the sloughs and smaller depressions where saline or even alkali conditions prevail. As they now exist, these low areas have limited use and may prove to be a problem under an irrigation economy. They may become seep spots or waterlogged areas should the higher slopes be irrigated in the future. The lack of water, on the one hand, and the danger resulting from excessive water, on the other, creates a dilemma which must be overcome. To improve surface drainage by opening up channels through all depressions would prove impractical and expensive. Even subsurface systems for draining off excess water might be prohibitive in cost. Among the ways of improving percolation in the soil are (1) greater use of grasses and legumes in a rotation involving adapted and salt-tolerant crops (which would be a partial solution to the difficulty since they would help improve soil structure and permeability) and (2), encouraging soil aggregation with the use of soil conditioners such as Krilium (which may in time prove feasible if its cost is lowered).

A soils map of the Oahe Unit and two cross-sectional diagrams are presented. The latter show the generalized profile characteristics of soils developed from till, and those developed from outwash and lacustrine materials to a depth of five feet. They indicate the depressions, the nature of the soil profile, and saline or alkali accumulations.

Many slick spots have grown since this area was first plowed. They will grow more rapidly under an irrigation economy. The loss of organic matter in the soils is undoubtedly the reason for this increasing heaviness. The systematic plowing under of green plant material will reverse this trend by increasing the amount of organic matter in the soil. This will help to build soil aggregates and thereby reduce puddling and increase percolation. These benefits should not be minimized.

Period of Irrigation Development

Because of great crop disasters, early settlers emigrated believing that the Great Plains was truly part of the "Great American Desert," and that the desert was claiming its own. Because of the alternating wet and dry climatic cycles of many years duration, populations tended to be unstable, moving on when they could not make a living during dry years. The land can and does support a large population under favorable climatic conditions, but this will not hold true if a dry cycle returns. Drought periods will return and much land will become submarginal. The agricultural population which remains will live in hope that the lean years cannot last, that good crop years will soon return. This unstable agriculture and population could become fixed and even increase appreciably if the attendent risks could be minimized.

Hoping to find some solution to this problem, the farmers and businessmen met with the Governor of South Dakota at Huron in 1934. They decided that the sorghums could aid them in their fight to survive. Sorghums, unlike corn, can remain dormant during periods of drought and continue growth when water is again available in the soil. Sorghum planting was encouraged, and there was a tremendous increase in acreage planted to sorghums in 1939. Gradually, however, the acreage in this crop declined, whereas that in corn increased, as a period of wet years advanced. Corn produces better if the moisture is sufficient and does not cause the prussic acid poisoning of livestock so prevalent with sorghum feeding. A new sorghum, "Norghum," developed in South Dakota, has overcome the major objections to sorghums. It is adapted to the comparatively short growing season and subhumid conditions in central South Dakota and is being increasingly used in the place of corn. This crop is undoubtedly the better under the present dry-farming conditions. However, corn will replace sorghum on irrigated fields because it does yield better where moisture is available and would give the greater returns in livestock production. Even though wheat is an important cash crop, corn, oats, tame, and wild hay (crops used in beef production) occupy a greater percentage of all farmland. The use of irrigation water, adapted varieties of crops, and pasture mixtures would tend to stabilize production, and the economy of South Dakota would benefit. Planning toward the establishment of an irrigation economy is now in progress.

Preliminary reports indicate that 59 per cent or 634,075 acres are in land classes 1, 2, and 3 (i.e. irrigable); 6.5 per cent is irrigable on a limited scale; 4.6 per cent is irrigable if technological improvements can make it so; and 29.9 per cent is nonirrigable.

Two experimental farms have been set up and are now operating by means of irrigation water pumped from the James River. Though results are not conclusive (the farms have been operating only a few years) there are indications that substantial increases in crop and livestock production are possible if the area is irrigated.

The Department of the Interior has issued joint cost

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allocations for the Corps of Engineers and the Bureau of Reclamation projects in the Missouri River basin. It includes all of the basin projects, not the Oahe Unit alone. The construction costs of the Oahe Dam are estimated at $258,200,000, with reimbersable allocations of cost to power of $133,355,000 and to irrigation of $53,190,000. The remaining $71,655,000 is the nonreimbursable cost assigned to flood control and navigation. If an average cost of development for new land is taken, the cost of developing the Oahe Unit would be around $330,000,000, about 35 per cent of which would be repaid by water users and reclamation or conservancy districts.

Industry could be expanded in the area. Among those suggested as possibilities are alfalfa dehydration plants, canneries, sugar factories, whole milk plants, and a potato starch factory, which together have a combined annual payroll of more than $2,500,000. Whereas it may be possible for these industries to develop, it is unlikely that such an optimistic view is justified. The market for the products of these proposed industries does not exist. Unborn and infant industries would have some difficulty in getting a market of good volume quickly enough to take advantage of carload commodity rates on low-grade manufactures. The more highly processed goods would also require a substantial market to offset the higher class rates to which they are subject. The market is not established and may be difficult to obtain. Should the population increase as indicated, some of the industries could develop slowly on the local market.

If the Oahe Unit is irrigated, the James River would have to carry excessive amounts of drainage water. Ways should be found now of disposing of this expected excess water before it reaches the James. The following are suggested as ways of accomplishing this:

1. Adapted and salt-tolerant varieties of trees which consume large quantities of water should be found, and certain drainageways planted with them. Salt cedar and cottonwood in Arizona were found to consume 7.2 and 6.0 acre-feet of water per acre per year, respectively.

2. Class 5 land above the laterals, particularly that composed of lighter textured soils, should be the experimental ground for farm or community woodlands. Should the soil be made to absorb large quantities of waste water, two highly desirable results will have been accomplished. Each farm or community would have its own source of timber, and ground water supplies would be increased to their original, or even higher, levels. Such a method of waste water disposal, if devised for the Oahe Unit, will need considerable study beforehand. Waste water has been disposed of successfully in the forest soils of New Jersey in experimental work at the Seabrook Farms. But the chernozems are not forest soils and experimental work will have to be carried on in an effort to determine their water absorption capabilities.

3. Construction of many farm ponds would allow for the slow downward percolation of water and the increase of ground water, and at the same time provide watering spots for livestock.

4. Or excess water could be pumped into wells located in large sandy or gravelly outwash areas such as the area to the west of Huron. Partial treatment of the water may be necessary beforehand, but if accomplished this might result in larger ground water supplies as well as a means of disposal of excess drainage water.

236 pages. $3.05. Mic 58-4824

Abstract published by special arrangement with The Ohio State University.

MACOMB COUNTY: A STUDY OF THE EXPANSION OF URBAN USES AND THE ABSORPTION OF FARMLAND

(L. C. Card No. Mic 58-930)

George Joseph Honzatko, Ph.D.
University of Michigan, 1957

The problem dealt with in the present study first is one of setting forth an approach by which the direction of urban expansion and the amount of land that will be required by urban uses in the future may be established. Second, a method is presented to determine the extent to which highly productive farmland will be absorbed by the expansion of urban uses. Such research is necessary to further study on seeking out ways leading to the economic integration of urban and agricultural land uses, and the preservation of farmland from excessive and premature urban absorption.

Macomb County, situated in the northeastern part of the Detroit metropolitan area, was selected for study. The county is characterized both by large tracts of productive farmland and intensive urban development, thus affording an opportunity to test the techniques developed in terms of the developmental history of the county as well as the metropolitan area.

The method for determining the amount of land that might be required by future urban expansion was based principally upon the land needs of major urban uses. Residential space requirements were calculated from the demand for new single and multiple family housing and from lot size requirements stipulated in present zoning ordinances. Industrial land requirements were calculated by determining acre per worker ratios for each major type of industry, and then using such ratios in conjunction with future employment estimates to arrive at land demand. Commercial land requirements were based on the relation between the amount of sales and acreage used for business, and projecting the resulting ratios in terms of future sales potentials. Land requirements for other urban uses were apportioned on the basis of past trends.

Farmland quality was determined by rating farmland according to its productivity, texture, drainage and value, and the value of crops sold. The pattern of farmland quality that was distinguished then was compared with a map showing anticipated urban land use to discover those areas of highly productive farmland that would be absorbed into urban use. The direction of recent residential platting (1950-1955) and the distribution of vacant land (1955) were used to derive a measure of the direction of future urban expansion.

The following conclusions may be drawn from the study: (1) the past expansion of urban uses in Macomb County has resulted in the absorption of about 65 square miles of farmland, (2) the rate of farmland absorption will increase, however, for by 1980 an additional 47 square miles will be in urban use, and (3) approximately 30 square miles of highly productive farmland will be absorbed into urban use by 1980, with an additional 15 square miles left in isolated tracts.

220 pages. $2.85.

THE INFLUENCE OF SHORE PROCESSES ON SHOREZONE UTILIZATION IN MICHIGAN

(L. C. Card No. Mic 58-933)

William Franklin Jewell, III, Ph.D.
University of Michigan, 1957

The increased significance of shore sites in recent years has brought with it a great number of problems for users of the shore. Classifications of the shore have not been suitable to the needs of the land use planner. The development of a technique of classification of the shorezone which would more nearly meet the needs of the land use planner is the objective of this study.

The requirements of each major type of use were examined and two factors, accessibility and stability, were found to have the greatest influence upon the permitting or denying of use of a shore site, as well as on the type and intensity of use. Problems of access or stability depend largely on four physical factors in the shorezone. They are: the configuration of the shorezone, its material composition, its exposure or susceptibility to change under the influence of the process, and the nature of the process itself.

An inventory was made of the physical nature of certain shorezone sites and of the nature of the static and dynamic processes found there. A detailed reconnaissance method was used, selecting sectors at intervals along the shores of Lakes Michigan, Huron, and Erie, and making detailed studies of the selected sites.

From the inventory it was possible to establish several classifications of the shorezone. First, there is the classifications of coastal types which is purely descriptive, although it permits inference as to the long term effect of the shore process. Second, there is the classification of process. Both the long term and the short term processes can be characterized as being neutral, prograde, or retrograde. Third, there is the classification of accessibility from the land and from the sea to the shoreline. Included in this classification is the statement of the amount of developable space immediately adjacent to the water plane. Fourth, there is a general use capability classification of the shorezone. Based on the criteria of the first three classifications, it can serve as a basis for zoning of shorezone property. The general use capability classification indicates the relative suitability of a site for intensive or dispersed use as well as the need for denial of use.

For broader determinations, involving large segments of the shorezone, a broad areal classification of shore types was evolved. Based on the attitude and material composition of the coast and on the nature of the process, twenty-four major coast types were developed which describe all of the shorezone conditions found on the Great Lakes.

This paper has been an investigation of a new field, seeking to establish a method for the primary land use determinations in the shorezone. From a basis such as this it should be possible to go on to the creation of detailed classifications of the shorezone for every type of land use. 151 pages. $2.00.

GEOGRAPHY AND POLITICS IN MISSOURI

(L. C. Card No. Mic 58-1421)

J. Trenton Kostbade, Ph.D.
University of Michigan, 1957

This study maps the areal pattern of the relative voting strength of the Democratic and Republican parties in Missouri. It then examines that pattern to determine its fundamental characteristics and its relationships to other aspects of the state's geography, both past and present.

The pattern is mapped in terms of average Democratic and Republican percentages of the two-party vote during the period 1940 to 1950 in each county. For greater detail the results of a single election, the senatorial election of 1950, are mapped on a township basis. The pattern delineated in these terms is then analyzed with respect to the intricacy and diversity it displays, its relation to local political control, and the short-term variability of its various segments.

Other selected geographic patterns in Missouri are mapped and are compared with the pattern of relative party strength. The patterns selected include physical divisions and drainage, urbanization, industrialization, agricultural employment and types of farming, religious preferences, and nonwhite population. Degrees of areal association between these patterns and the political pattern are determined. The significance of associations is checked by analysis of the relations of the selected patterns to political trends since the 1920's.

The pattern of relative party strength is then mapped as it existed at selected periods in the past. Some of its major outlines are found to date from the Civil War and Reconstruction period. Historical maps are used to relate its origins and evolution to certain geographic patterns of the past, notably to patterns of immigration and settlement.

The principal conclusions of the study concern: (1) the forces which have shaped the pattern of relative party strength, (2) the relationships of that pattern to other aspects of the state's contemporary geography, (3) the fundamental characteristics of that pattern.

1. The general outlines of the pattern of party strength were shaped in the nineteenth century by contrasts between different sections of the state with respect to the development of slavery, Civil War experiences, and the origins of settlement. These outlines have been modified in some particulars by political trends operative since the 1920's. The most conspicuous of these trends have been Democratic trends in the more urban and industrial counties and in the state's cash crop farming area. Weaker trends, both Democratic and Republican, have affected certain other types of agricultural counties.

2. Tradition has kept the pattern of party strength relatively static. Consequently, most relationships between the current pattern and other aspects of Missouri's contemporary geography are partial and laden with exceptions. The most striking general relationships, which are due largely to political trends since the 1920's, are those between Democratic predominance and urbanization, industrialization, and cash crop farming. Due to the continuing influence of original settlement on party strength Republican predominance is general in rural areas where certain church groups, associated with settlement groups, now have outstanding importance. These groups include

the Methodist Episcopal (now reunited with the Southern Methodists), the Catholic (largely German in Missouri), and the German Protestant denominations.

3. The outstanding and fundamental characteristics of the pattern of party strength in Missouri are its intricacy, its over-all balance between extremely diverse areas, which makes the state politically doubtful, its long-term stability, and its short-term variability. Above all, the entire study demonstrates that the pattern is too intricate to permit sweeping generalizations about the political character of large sections of the state. Fourteen regional divisions are required to summarize the pattern of party strength regionally, and even these divisions contain much internal diversity. 398 pages. $5.10.

HISTORICAL GEOGRAPHY OF CHAMPAIGN COUNTY, ILLINOIS

(Publication No. 25,285)

Marjorie Corrine Smith, Ph.D.
University of Illinois, 1957

The area, Champaign County, Illinois, is a political unit in east-central Illinois. It is a rectangular block thirty-six miles in north-south extent and twenty-eight miles from east to west, near the center of an area that has been recognized as a geographic region, homogeneous in climate, vegetation, surface features, drainage and manner of utilization by man. The climate is humid continental with a long summer, the surface is undulating plain. The original vegetation was tall grass prairie with groves along the streams and in patches near swamps. The drainage into the Vermilion-Wabash River system and the Illinois River system was poorly established and there was much swamp land. The vegetation and drainage have been much modified by man in establishing the present cash-grain farming economy.

There is much homogeneity in rural, village, and urban occupance. Farms and farmsteads offer little variety in field patterns or buildings or fence rows. Towns, villages and hamlets have the same kind of commercial core: grain elevators, shops and farm services. The three cities, Champaign, Urbana and Rantoul have many of the same characteristics as the towns and villages. The railroad system is a cross pattern offering north-south and east-west transportation. The roads, a denser system, offer the same pattern.

Within the general physical and cultural homogeneity of the area are anomalies and contrasts which suggest that variations of the pattern are in part the result of differently felt external influences and in part relics of former occupancies.

There were five periods of occupancy of Champaign County each dominated by a critical element. Dates ending each period and the dominant element are as follows:

1833 - the introduction of a new culture into the area;

1854 - the development of the resources of the area according to the beliefs and technologies of the time;

1880 - the construction of railroads;

1910 - the change in the dominant economy from animal husbandry to grain farming;

1930 - the introduction of the gasoline engine for power and transportation.

The critical elements of occupancy causing changes in the geography of Champaign County were changes in state and nation and not peculiar to Champaign County itself. However variations from national development were initiated within the area. No change from one type of occupancy to another was constant. Occupancy features of one period often persisted far into a time when they had lost their functional value. Physical, technological, economic and sociological changes proceeded simultaneously, but not at the same rate; each affected the others but not equally.

Occupancy of the rural area of Champaign County has shifted from woodland farm, to livestock ranching, to intensive grain agriculture. The years 1850 to 1870 were years of rapid growth of agricultural service towns which are major features of the area.

The cities of Champaign-Urbana and, Rantoul, have become complex manufacturing and commercial cities. Part of the manufacturing is based on local raw materials and part on a labor supply built up with the decrease in demand for labor on farms. Since 1880 the growth of population of Champaign and Urbana has been the greater part of the growth in population of the county

The cash-grain economy of Champaign County was established by 1910 and has been stable since that time. Animal husbandry fluctuates from year to year but remains secondary to grain farming. The numbers of people in industrial, commercial, and institutional occupations of the county are greater than those in agriculture but the greater area and a great wealth are in the cash grain farms.
184 pages. $2.40. Mic 58-4825

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GEOLOGY OF PAWNEE COUNTY, OKLAHOMA

(L. C. Card No. Mic 58-591)

Paul Bennett Greig, Jr., Ph.D.
The University of Oklahoma, 1958

Major Professor: Carl C. Branson

Sedimentary rocks of the Upper Pennsylvanian, Lower Permian, and Quaternary systems are exposed in Pawnee County. Pennsylvanian beds range upward from the Wann formation of upper Missouri age to the Brownville limestone of uppermost Virgil age. They are overlain with apparent conformity by a Permian sequence containing Wolfcamp sediments up to and including the Winfield limestone formation of the Chase group. Quaternary deposits and alluvium lie unconformably on the truncated edges of the Paleozoic strata.

During Upper Pennsylvanian and Lower Permian time the Pawnee County area was situated between an eroding landmass to the south and a cyclicly subsiding marine basin to the north. The resultant sediments form a complex sequence transitional between the coarsely clastic continental deposits of the source area and the cyclic primarily marine deposits of the basin. Subdivision and classification of this transitional sequence require the use of nomenclature from both the marine and continental sections.

In upper Missouri and lower Virgil time deposition was controlled largely by conditions in the source area, and the rocks are mainly interbedded sandstones and shales of continental and deltaic origin. Southward encroachment of a marine environment and a concurrent decrease of source material is indicated in upper Virgil and lower Wolfcamp time by subcyclic deposition of sandstones, shales, thin limestones, and coals. A thick red bed sequence of upper Wolfcamp age records rejuvenation of the source area and retreat of the sea, although a marine environment recurred periodically over much of the county during this time.

The subsurface section is primarily of marine origin and includes beds of Cambro-Ordovician, Ordovician, Mississippian, Pennsylvanian, and Permian age.

The sedimentary sequence contains four major angular unconformities and at least four minor unconformities. The westerly dip of the beds is interrupted locally by north-trending belts of en echelon faults and small dome-like folds. Faulting and folding are attributed to horizontal and vertical movements, respectively, along ancestral zones of weakness in the granite basement. Folding took place recurrently throughout Pennsylvanian and Lower Permian time. The faulting probably occurred in late Permian or early post-Permian time, when the sediments were uplifted and tilted westward. The area was subsequently peneplaned and later rejuvenated. Dissection of the peneplane is currently in progress.

The county's chief mineral resource is oil. Potentially valuable deposits of clay and building stone and non-commercial deposits of coal, copper, and radioactive minerals are also known. 290 pages. $3.75.

SPECTROCHEMICAL ANALYSES OF CARBONATE ROCKS

(L. C. Card No. Mic 58-1312)

James David Hume, Ph.D.
University of Michigan, 1957

The initial problem was the determination of the tectonic and sedimentary history of the Michigan basin during the Niagaran epoch. As an aid in solving the problem, a new and more accurate method of analyzing carbonate rocks with a spectrograph was developed.

Analyses of 373 subsurface samples from 16 wells and 124 outcrop samples were made with a quartz prism, Littrow type spectrograph. An exposure of 60 seconds with an A.C. arc was used on powdered samples mixed with cupric oxide and graphite. SiO_2, Fe_2O_3, Al_2O_3, MgO, and CaO were determined with a reproducibility of approximately $\pm$ 10%. All analyses were made in duplicate. Samples were also examined by ordinary geologic techniques.

It was found that the Clinton formation can be recognized easily by spectrochemical data. Furthermore, it was found that the Lockport dolomite can be subdivided into three units. The A Unit at the base is characterized by its extreme purity, the B Unit by two characteristic strata of slightly higher values of silica, and the C Unit by its high silica, iron, and alumina. These lithologic units can be traced from well to well.

Lithofacies maps of the Lockport dolomite show an area in central Michigan containing limestones with the greatest quantities of SiO_2, Fe_2O_3, and Al_2O_3. These impurities gradually decrease to the south and west where the Niagaran rocks become dolomitic. The strata also thicken away from this area.

The data are interpreted to mean that Michigan was an area of shallow seas during Clinton time. In these seas, sediments from the northeast were deposited to form shales and dolomites. Following their deposition, a northeast trending arch formed across the Michigan basin. This arch, in conjunction with reefs to the east, west and south, restricted the circulation of water in the southern part of the basin. Semi-evaporite conditions developed and primary dolomites were deposited. Occasionally impurities were washed into the basin from the northeast over the "trans-Michigan" arch.

It was finally concluded that the spectrograph can be applied usefully to subsurface correlation studies. Spectrochemical analyses can also be used for interpretation of depositional environments and geologic history. However, if correlation of rock units is the only objective, the results probably do not justify the time and cost.

141 pages. $2.00.

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A CRETACEOUS FLORA FROM NORTHERN ALASKA

(L. C. Card No Mic 58-947)

John Stewart Lowther, Ph.D.
University of Michigan, 1957

This report deals with fossil plants from the Nanushuk group, a rock unit which is extensively exposed in the northern foothills of the Brooks Range in northern Alaska. The plants come from the non-marine Chandler and Corwin formations which are reported to intertongue northward with marine rocks. The study is based on over eight hundred specimens representing nearly a hundred localities situated mainly in the valleys of the Colville, Ikpikpuk, Meade, Kuk, Avalik, Kaolak, Utukok, Kokolik, and Kukpowruk Rivers, and on the arctic coast between Cap Beaufort and Corwin Bluff. Most of the material was collected in 1951 and 1953 by field parties from the University of Michigan, but the author has also examined most of the paleobotanical collections from the region in the United States National Museum. The main objects of this work are (1) to describe the flora, (2) to compare it with similar floras from other parts of the world, and (3) to suggest the age of the plant-bearing rocks.

Forty-seven species are recognized in the Nanushuk flora. These consist of two thallophytes, one lycopod, one equisetum, eight ferns, six cycadophytes, twelve ginkgophytes, eleven conifers, five dicotyledons, and one incertae affinitatis. Ferns and gymnosperms comprise about ninety-five per-cent of the total collection. Seven species do not occur outside of the Nanushuk group, fourteen can only be determined generically, and the remainder are identified with species that occur in other places. Twelve species have been found elsewhere mainly in the Jurassic and rarely above the lowermost Cretaceous; four were not previously known outside of the Upper Jurassic; two range through the Upper Jurassic and Lower Cretaceous but are most common in the earliest Cretaceous; and five have been reported previously only from the Lower Cretaceous of Svalbard and Greenland. Only three of the forms have been identified in Upper Cretaceous floras.

The flora of the Nanushuk group appears to be most closely related in composition to that of the Upper Neocomian of Svalbard, but it also shows strong correlations with those from the Middle Jurassic of Yorkshire and the Upper Jurassic and lowermost Cretaceous of central and eastern Asia. It has very little in common with any known Upper Cretaceous flora.

The Nanushuk flora is determined to be of Upper Neocomian age because (1) more than one-third of the species are common constituents of Jurassic floras in other parts of the world, (2) less than a dozen Nanushuk species have been reported elsewhere from strate younger than Aptian, and (3) it shows a strong degree of correlation with the upper Neocomian flora of Svalbard. Angiosperm remains do not constitute a large enough fraction of the total collection to be used as evidence of an Aptian age.

On the basis of five "index species" of invertebrates from the marine formations, the Nanushuk group has been assigned to the middle Cretaceous (Albian-Cenomanian). Suggested explanations for this discrepancy in age determinations from plant and animal evidence are: (1) the invertebrate paleontologists have relied too heavily on a small number of so-called index fossils; (2) the marine formations of the Nanushuk disconformably overlie, and hence are younger than the non-marine rocks; and (3) the non-marine Chandler and Corwin formations which contain the plants are equivalent to marine formations that underlie the Nanushuk group. 212 pages. $2.75.

GEOLOGY OF HARPER COUNTY, OKLAHOMA

(L. C. Card No. Mic 58-1438)

Arthur John Myers, Ph.D.
University of Michigan 1957

Harper County, covering approximately 1075 square miles, is in northwestern Oklahoma. Aerial photographs were used in the field mapping of this semi-arid region. The bed rock consists of Permian and Cretaceous clastic and evaporite sediments approximately 535 feet thick, covered in the southwest by about 135 feet of Pliocene and Pleistocene continental deposits. The region is in the Plains Border of the High Plains Physiographic Province and most outcrops are bluff exposures.

In ascending order, the unfossiliferous Permian rocks consist of the Flowerpot shale, Blaine formation, Dog Creek shale, Whitehorse group, and Cloud Chief formation. The Flowerpot shale is a brownish red gypsiferous shale. The Blaine formation consists of four named massive gypsum members separated by red shale: (ascending) Medicine Lodge, Nescatunga, Shimer, and Haskew Gypsums. The Dog Creek shale is a brownish red, even-bedded shale with thin beds of fine grained sandstone. The Whitehouse group includes the Marlow formation, which is an orange red, fine-grained, locally cross-bedded sandstone, and the overlying Rush Springs sandstone consisting of brownish red interbedded sandstone and shale. The Cloud Chief formation is predominantly a maroon red shale with some gypsum and contains the resistant Day Creek dolomite at its base. The Cretaceous Kiowa shale outliers consist of yellow to gray to black shales, sandstones, and conglomerates with some fossiliferous beds. The Pliocene deposits include (ascending) the Laverne formation, buff, blue gray, and gray shales, sandstone, and conglomerates, and the Ogallala formation, pink, tan, and gray gravels, sands, and silts. The Pleistocene deposits are the Crooked Creek formation of the Meade group, which consists of tan to pink gravels, sands, and silts and the Pearlette volvanic ash lentil, post Crooked Creek dune sand, and gray to black clay and silt lake deposits. The Recent deposits are the terraces, alluvium, and dune deposits along recent streams.

During Permian time clastics and evaporites accumulated in marine embayments which covered western Oklahoma. Following this a period of erosion lasted during most of the Triassic and Jurassic periods. By Cretaceous time marine seas again covered the extreme western part of Oklahoma, and received clastic sediments from the west. Erosion again predominated during most of the Tertiary, but during the Pliocene two cycles of fluvial deposition by east flowing streams were separated by an intervening period of erosion. Later Pleistocene meltwater streams from the retreating Rock Mountain glaciers eroded channels in the pre-Pleistocene surface, but a cycle of fluvial deposition followed soon after. The last episode

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of Pleistocene history involved the deposition of lacustrine sediments in shallow sink basins of local extent.

The Permian and Cretaceous rocks have a dip of 30 feet per mile to the south. The Tertiary and Quaternary deposits are essentially horizontal. Sink hole development has resulted in minor localized folding in all rocks.

Recent wide-spread drilling has shown a potential oil and gas supply but production is awaiting pipe-line facilities. Isolated sand and gravel deposits are used locally for road construction. The massive gypsum deposits of the Blaine formation may have economic possibilities. The volcanic ash deposits are small and would not permit large scale operation. 156 pages. $2.05.

STRUCTURAL GEOLOGY OF THE MOROCOCHA DISTRICT, PERU

(L. C. Card No. Mic 58-1297)

Raymond Harris Nagell, Ph.D.
Stanford University, 1958

The Morococha mining district, located 70 miles east of Lima in central Peru, is a source of copper-silver-lead-zinc ores.

The layered rocks of the district consist of the Permian Catalina volcanics and the Jurassic Potosi formation of limestones. These are 2,500 and 1,500 feet thick respectively.

During the Andean orogeny, which began at the end of the Cretaceous and continued through the Tertiary, the volcanic and sedimentary rocks were folded in a north-striking anticlinorium and were broken by north-striking thrust faults and tectonic breccia zones.

Diorite and quartz monzonite stocks formed in the crest and western flank of the anticlinorium.

Rock alteration accompanied emplacement of the intrusives and the later ore mineralization. The Catalina volcanics and the intrusives are silicified and sericitized. The Potosi formation is altered to marble, dolomite, calcic hornfels, hydrated silicate rock, skarn, and anhydrite. These alteration products exhibit a zonal pattern controlled by compositional variations in the Potosi formation and metasomatic effects of the intrusives.

East-striking oblique fractures attained maximum development following consolidation of the intrusives. These are mostly normal faults of small displacement and they cut all rocks except the anhydrite and the lower part of the Gertrudis stock.

The east-west compressive stresses which formed the lineaments, crossfolds and fractures of the Andes also formed the major structural elements of the Morococha district. Prior to the intrusion of the diorite and quartz monzonite stocks, the anticlinorium, thrust faults, and crossfolds had been formed. Metasomatic alteration of the Potosi formation, the development of igneous and alteration contacts, and the oblique fracturing are regarded as ground preparation for the ore deposits which followed. The localization of the ore deposits is a consequence of these structural controls.

The major economic ore minerals are enargite, tetrahedritetennantite, chalcopyrite, sphalerite, and galena. In the order named, these minerals exhibit a zonal pattern from the center to the periphery of the district. Ore bodies are in the form of veins, pipes, and mantos.

The development of the structural controls of ore localization follows an orderly pattern throughout the deformational history of the district. The development of the anticlinorium early in the history of the district controlled the shape of the intrusives and the distribution of the altered horizons of the Potosi formation. Thrust faults, although they are not hosts to vein ore bodies, formed zones of weakness at the intersections of the oblique fractures which localized pipes and mantos.

Pre-intrusive tectonic breccias influenced the distribution of the intrusives and are hosts to mantos. Post-ore collapse breccias, associated with the anhydrite complex, scattered and diluted adjacent ore bodies.

The intrusives formed channels of ascent along their contacts with the Potosi formation for the later ore solutions. Where these contacts were weakened by movement on the oblique fractures, contact pipes formed. Thermal gradients established by the intrusives exerted a strong influence on the mineralogical distribution of the ore bodies. Thermal and metasomatic effects of the intrusives on the host rock produced a layered sequence of alteration products. Silicification and silication formed brittle rocks supporting well defined vein structures. Hydrothermal alteration of the silicated alteration products and anhydritization formed soft plastic rocks. Ore shoots in the veins are localized in the brittle rocks. These variations in the physical properties of the rocks determined the strength and the attitude of the vein structures. Contacts between the various types of altered rocks, especially where intersected by oblique fractures, provided zones of weakness amenable to the formation of mantos.

The oblique fractures are the hosts for the vein ore bodies. The intersections of these fractures with igneous contacts, contacts of the various types of altered limestone, and the Gertrudis thrust fault provided direct structural control of the location of pipes and mantos.

The recognition of these structural controls on the localization of ore bodies permits effective exploration for new ore bodies in the Morococha district.

184 pages. $2.40

GEOLOGY OF THE PRECAMBRIAN ROCKS OF THE KEYSTONE PEGMATITE DISTRICT, SOUTHERN BLACK HILLS, SOUTH DAKOTA

(L. C. Card No. Mic 58-1353)

James Jennings Norton, Ph.D.
Columbia University, 1957

The Keystone pegmatite district is on the northeast flank of the mountainous area around Harney Peak in the southern part of the Precambrian core of the Black Hills, South Dakota. The chief mineral products have been potash feldspar, spodumene, amblygonite, lepidolite, beryl, scrap mica, and gold. Gold mining was important from 1891 to 1903. Pegmatite mining began in 1898, and has been a major activity since about 1929. Approximately 18 square miles have been mapped geologically at a scale of 1;10,000 in and near the pegmatite-bearing area of the Keystone district.

The Keystone district contains an estimated thickness of 11,000 feet of metasedimentary rocks. These are mostly quartzose and micaceous schists; other rocks include amphibole schist, quartzite, and mica-graphite schist. Orthoamphibolite intrudes the metasedimentary rocks.

All metamorphic rocks of the southern Black Hills increase in grade toward the area of abundant pegmatitic intrusives near Harney Peak. The southern and southwestern part of the Keystone district is in the sillimanite zone; staurolite is the highest grade mineral elsewhere.

The metamorphic rocks were deformed first by isoclinal folds, then by intense cross folds, and finally by gentle flexures associated with pegmatite intrusives. The plunges of isoclinal folds are generally more than 70° in the north and northeast parts of the district, but are ordinarily between 0° and 50° elsewhere.

A large transcurrent fault strikes northwest across the district. Smaller high angle faults have been recognized both in the vicinity of the main fault and also in the northwest part of the district. The abundance of faults in the Keystone district, at the edge of the pegmatite-bearing area of the southern Black Hills, suggests that faulting was caused by forces associated with intrusive activity. Faults cut the isoclinal and cross folds, but they preceded the climax of the progressive metamorphism that affected the rocks surrounding Harney Peak.

Pegmatites of the Keystone district and other parts of the southern Black Hills are here classified as layered, homogeneous, and zoned pegmatites. Layered pegmatites consist of relatively fine-grained plagioclase, quartz, and muscovite with layers and lenses of coarser-grained pegmatite made up of perthite, quartz, and plagioclase. Homogeneous pegmatites are composed virtually entirely of unsegregated plagioclase, quartz, perthite, and muscovite. Zoned pegmatites are the least common variety, though they have been widely described in the literature.

An isopleth map showing the abundance of pegmatites throughout the southern Black Hills indicates that the pegmatites are concentrated around the Harney Peak dome and many satellitic domes. Layered pegmatites are most abundant within these domes, and homogeneous pegmatites are most abundant on the flanks. Zoned pegmatites are in a belt at the outer edge of the pegmatite-bearing area. The Keystone district, on the northeast side of the Harney Peak dome, contains all three types of pegmatites. The belt of zoned pegmatites goes northwest through the Keystone district, where it is 1 to 2 miles wide.

Structural, mineralogic, and petrographic evidence suggest that these pegmatites formed from a magma-like liquid. The internal structure indicates that zoned pegmatites formed in an essentially closed system, but layered pegmatites may have crystallized in a more open system. All varieties of pegmatite have approximately the same content of SiO_2, Al_2O_3, Na_2O, and K_2O. The fluid from which the zoned pegmatites formed may, however, have been enriched in H_2O, B, F, and such "rare" constituents as Li and Be. Hydrothermal or pneumatolytic fluids given off during crystallization of zoned pegmatites formed replacement bodies that cross-cut the zonal structure.

Nearly all pegmatite mining in the Keystone district has been in zoned pegmatites. Units in these pegmatites contain minable concentrations of potash feldspar, lithium minerals, scrap mica, beryl, and small quantities of other industrial minerals. 235 pages. $3.05.

HEALTH SCIENCES, GENERAL

A STUDY OF CANINE HAEMOBARTONELLOSIS

(L. C. Card No. Mic 58-1126)

William Valjean Lumb, Ph.D.
University of Minnesota, 1957

Adviser: George W. Mather

Haemobartonella canis was first discovered by Kikuth in Hamburg, Germany in 1928. Since then its distribution has been shown to be world-wide. It has been reported four times previously in the United States.

The organism is very pleomorphic, rings, cocci both singly and in chains, rods and violin-bow forms being commonly encountered. They are found on and perhaps within the red cell on stained smears and are easily seen using an oil immersion objective.

A dog suffering from haemobartonellosis was seen by Benjamin and Lumb at the Colorado State University Veterinary Hospital, Fort Collins, Colorado in January 1956. This study resulted from problems arising in the management of this case.

Experimentally in dogs with an intact spleen Haemobartonella canis produces a latent infection with few symptoms. No change occurs in the blood picture and no organisms are seen in blood smears from these animals. Splenectomy will activate the infection present in these animals and is to be avoided. A positive diagnosis can be made only by inoculation of a susceptible splenectomized animal with blood from the suspect.

In splenectomized dogs Haemobartonella canis produces an acute or chronic infectious anemia characterized by high morbidity and low mortality. The anemia is macrocytic hypochromic in type. A fluctuating leucopenia is seen during the course of the infection. The organisms in the blood present a characteristic appearance and exhibit a variable periodicity. At the height of the disease listlessness and pale mucous membranes are the chief symptoms. Diagnosis is based on history of splenectomy followed by anemia and demonstration of organisms in blood smears.

Pooled blood samples from 100 dogs in the the Fort Collins, Colorado area were injected into susceptible splenectomized dogs. In this fashion the incidence of haemobartonellosis was determined to be at least 8.0 per cent in dogs over a year of age.

The items following each abstract are: the number of manuscript pages in the dissertation, its cost on microfilm, and the Library of Congress card number. Enlargements 5-1/2 x 8-1/2 inches, 4 cents per page. No postage is charged if check or money order accompanies order.

Experiments designed to determine the mode of natural transmission were conducted. Transmission by contact, lice, in utero and through maternal milk could not be effected.

Some dogs receiving infective blood orally did develop the disease. This suggests that transmission could occur through ingestion of vaginal secretion from females in season and through dog fights. Unclean medical and surgical practices might also be a source of transmission.

The disease was transmitted through transfusion of whole citrated blood from an infected donor. Such blood lost its infectivity when stored in ACD solution at 6 to 8° Centigrade for at least three days.

One dose of 4.5 milligrams of Mapharsen per kilogram of body weight was found to be specific treatment for the disease. A rise in hemoglobin and hematocrit values followed treatment.

The infection was found to persist in splenectomized dogs for as long as one calendar year. Recovery from the disease conferred immunity if the disease had run its course. If terminated by treatment the dogs could be reinfected. 123 pages. $2.00.

HEALTH SCIENCES, NURSING

THE NURSE IN THE SCHOOL HEALTH SERVICES PROGRAM: IMPLICATIONS FOR DETROIT PRACTICES

(L. C: Card No. Mic 58-1181)

Robert R. Luby, Ed. D.,
Wayne State University, 1957

Please see page 1319 for abstract. 332 pages. $4.25.

HEALTH SCIENCES, PATHOLOGY

DISSOCIATION OF LIVER CELLS

(L. C. Card No. Mic 58-977)

Charles Glenwood Rickard, Ph.D.
University of Michigan, 1957

Dissociation of liver cells is made evident by a separation of the hepatic parenchymal cells so that spaces appear between them. When the condition is severe, the normal arrangement of the cells in cords or plates is no longer apparent in ordinary histological preparations.

Liver cell dissociation has been reported most frequently in Weil's disease (leptospirosis). It has been described also in heat stroke, infectious mononucleosis, ulcerative colitis, biopsy specimens from nonfatal cases of infectious (viral) hapatitis, in association with hepatic necrosis of various causes, as one of the changes in postmortal autolysis, as a part of the process of "serous hepatitis", and as an agonal change.

In an effort to determine if there is a general pattern of circumstances under which dissociation of liver cells develops, the necropsy records in the Pathology Department at the University of Michigan Hospital were studied. Descriptions of liver cell dissociation were found in 28 cases among 13,059 routine necropsies. The causes of death in the 28 individuals were summarized and compared with a control series of 280 necropsies. Death from exsanguination occurred in a highly significant incidence among the necropsies with dissociation of hepatic cells. No other cause of death varied significantly in incidence from the control series.

An unfixed liver with dissociation of the cells was somewhat soft and slightly swollen, but could not be distinguished grossly from other degenerations. The microscopic appearance was not influenced significantly by the method of fixation. Hepatic cell dissociation could be observed as well in unfixed liver, cut by the frozen-section technique, and examined by phase-contrast microscopy, Reticulum stains of various stages of the lesion demonstrated that the dissociation of the cells occurred within an essentially normal reticular framework. There was some collapse of sinusoids. The dissociated cells changed from a polyhedral to a more nearly spherical shape.

A comparison of postmortem autolysis with dissociation of liver cells revealed histological criteria for differentiating them.

The pathogenesis of liver cell dissociation was observed in experimental Leptospira infections in hamsters. Dissociation of the liver cells was produced by slow, fatal exsanguination (hemorrhagic shock) in dogs.

Intraperitoneal or subcutaneous injections of concentrated solutions of sucrose or glucose into hamsters caused dissociation of hepatic cells (presumably by withdrawing intracellular water) in 30 to 90 minutes. In hamsters that lived long enough to permit later observations, the dissociation persisted for about five hours; the liver cells then returned to a normal appearance. Anoxia did not cause liver cell dissociation, or make more severe a moderate dissociation produced by sucrose injection.

Perfusion of solutions of saponin or a detergent through a fresh liver also produced cellular dissociation; these are drastic means that probably do not resemble the pathogenesis in natural disease (except possibly a poisoning by such substances). Perfusions with bile or solutions of disodium versenate caused extensive destruction, resembling necrosis. Physiological saline or hyaluronidase solutions had no appraciable effect.

Attempts to demonstrate that a lecithinase or other enzyme is involved in the pathogenesis of liver cell dissociation were unsuccessful. Oral administration of neomycin to inhibit intestinal bacteria did not prevent the typical dissociation of hepatic cells in experimental leptospirosis.

The question of whether dissociated liver cells are complete, intact cells with unruptured plasma membranes was investigated. Dissociated liver cells were not stained intravitally by trypan blue, in the way that necrotic and prenecrotic liver cells can be stained. They appeared intact when suspended unfixed in 30 per cent blood albumen and viewed by phase contrast microscopy, according to the technique of Barer et al. In electron micrographs of early liver cell dissociation in experimental leptospirosis the plasma membranes appeared intact. 123 pages. $2.00.

HEALTH SCIENCES, PUBLIC HEALTH

CONSISTENCIES IN THE PREPARATION AND WORK OF THE PUBLIC HEALTH EDUCATOR

(L. C. Card No. Mic 58-1022)

Robert Albert Bowman, Ph.D.
University of Michigan, 1956

The major purpose of this study was the examination of the thesis, as it affects the public health educator, that there should be a pattern of consistency among (1) the tasks

performed by persons practicing a profession, (2) the requirements of the agencies employing individuals in that profession, (3) the educational program designated by universities to prepare persons for this profession, and (4) the qualifications expected or recommended by the profession.

Data were obtained from surveys of (1) 199 merit system statements for 151 health educator positions in forty-seven state and five territorial health agencies and for eighty-eight positions in local health agencies dispersed in twenty-eight states and two territories; (2) 100 selected public health educators of whom forty-eight were employed in state or territorial, thirty-seven in county, and fifteen in city health agencies dispersed in thirty-three states and four territories; (3) the content of the educational programs for health educators in seven schools of public health as perceived by faculty directing these programs; and (4) the stated educational qualifications for public health educators prepared by the American Public Health Association Committee on Professional Education.

An item analysis of the merit system statements was made, frequencies determined, and groupings established. These were duties and responsibilities, knowledge and understanding, abilities and skills, personal traits, educational background, and experiential background. Questionnaires based on these groupings were then constructed to obtain comparable information from practicing health educators and faculty members in the schools of public health. A time analysis by 76 of the health educators permitted a more intensive study of their tasks.

Responses were categorized and relationships between the frequencies were studied. The response in each category was ranked according to the emphasis it received and consistencies with comparable data selected from three sources were determined by the Kendall rank correlation method. The data on educational and experiential backgrounds from all sources and for the statement of educational qualifications were not amenable to statistical treatment but were analyzed and compared wherever possible.

Statistical significance was demonstrated for only one of the correlations used to determine consistency. However, when the correlation coefficients were utilized as general indices, these general findings were evident:

1. No definite pattern of consistency was apparent.
2. High consistency (>0.60) was found for the duties and responsibilities of health educators provided for in the curriculums of the schools of public health and stated for merit system positions, for the abilities and skills considered important by selected public health educators and stated by merit systems, and for the personal traits considered important by the schools and by the health educators.
3. Moderate consistency (0.30 - 0.59) was found for the duties and responsibilities discharged by public health educators and provided for in their preparation, for the abilities and skills provided for in the school curriculums and stated for merit system positions, and for the personal traits perceived important by the health educators and stated for merit system positions.
4. The frequency with which health educators discharged certain duties and responsibilities was found unrelated to the time devoted to these activities.
5. No consistency was found for the knowledge and understanding important to public health educators as stated by merit systems, included in the curriculum by schools of public health, and perceived important by the selected public health educators.

It was concluded that (1) the thesis proposed was not substantiated completely when applied to the preparation and work of the public health educator but consistency was found between certain item comparisons; (2) the scope of duties and responsibilities, knowledge and understanding, and abilities and skills of public health educators is very broad.

The findings of this study contain suggestions for improvement of the professional preparation and assignment of public health educators. 477 pages. $6.10.

HISTORY

HISTORY, GENERAL

THE ST. LAWRENCE PROJECT: A CASE STUDY IN AMERICAN POLITICS

(Publication No 24,491)

Dwayne Thomas Thompson, Ph.D.
George Peabody College for Teachers, 1957

Major Professor: Kenneth Cooper

The struggle to obtain the St. Lawrence Seaway and Power Project was a problem in American politics for over fifty years. In 1954 Congress approved a plan for cooperation with Canada in a joint enterprise. The victory in Congress was achieved by certain economic groups, which hoped to profit from the project. It received the support of certain members of both the Republican and Democratic parties.

The purpose of the study is to investigate the political aspects of the problem. Although an economic analysis is not attempted, the influence of economic factors on political behavior is shown. After World War I the project received considerable support because it was considered an asset for national defense. It is interesting to note that those who supported the project for economic reasons also thought it would contribute to national security. Those who opposed the project for economic reasons did not think it valuable as a defense measure. It seemed that each group saw in the project what it wished to see.

The methods used in this investigation are the historical narrative and the topical analysis. The historical

narrative technique is used to trace the political history of the project from its origin in the last decade of the nineteenth century.

The topical analysis method is used to show the influence of the basic issues in the political contest. During the debates there were three major issues: transportation, hydroelectric power, and the international aspect. The national defense aspect of the project is considered as a part of the larger issue of transportation. Although these issues had a direct interrelationship, the separate treatment of each topic enables the reader to see more clearly the importance of each issue.

There are several conclusions that can be drawn from this study.

1: Although the farmers of the West initiated the first attempt to get the project in the belief that it would aid agriculture, its final acceptance by Congress showed the political influence of the industrial Midwest that had become alarmed over its iron ore supply.

2. From the beginning the project was generally supported or opposed for sectional or economic reasons.

3. The project was endorsed by every President since Woodrow Wilson, yet no President could get the full support of his party in Congress to pass the necessary legislation.

4. The nature of the problem caused members of Congress to join hands with their political opponents of the opposite party. 268 pages. $3.45. Mic 58-4826

HISTORY, ANCIENT

A COMPARISON OF THE HELLENIC LEAGUES OF PHILIP II AND DEMERTRIUS I OF MACEDONIA

(L. C. Card No. Mic 58-971)

Christos Christou Patsavos, Ph.D.
University of Michigan, 1957

The purpose of this study is to examine and describe in every possible detail what are known in history as the Hellenic leagues of Philip II and Demetrius I of Macedonia and to determine the relation existing between the two federations by a comparison of their constitutions as they appear in the available epigraphical and literary material.

The treatment of the subject as described above is new and original; for although several articles have already been written dealing with these leagues, they are either of a general nature or are concerned only with certain particular points of one or the other federation and so far no work has been published which attempts a thorough and systematic treatment of either of the leagues, much less any comparison between them.

In the first chapter of the study, the epigraphic evidence bearing on the two federations is translated and interpreted. In the second chapter, a review of the historical background of the period preceding the founding of Philip's Hellenic League is presented for a better understanding of the events which led to its establishment. Chapter three is devoted to a detailed description of the constituent negotiations between Philip and the Greek states which resulted in the formation of Philip's Helenic League. The next two chapters attempt to reconcile previous differences of opinion and correct numerous errors concerning the nature of Philip's League and describe in detail the constitution of the League as it appears in the available epigraphic and literary sources. Chapter six examines the historical facts known about the establishment of the Hellenic League of Demetrius I of Macedonia, while Chapter seven attempts a detailed comparison between the constitutions of Demetrius' and Philip's leagues with a view to determining the relation existing between them.

Two general conclusions can be drawn from the study. 1) The Hellenic League of Philip II of Macedonia was a product of two political acts of different nature and content and diverse also from the point of view of the time they originated. The first of these political acts was an eternal συνθήκη κοινῆς εἰρήνης which established a state of peace among all the Greek states, except Sparta, as well as between them and Philip II of Macedonia; the second, was a συνθήκη κοινῆς συμμαχίας which established a state of alliance (symmachy) between Philip II of Macedonia and all the Greek states with the exception of Sparta, as well as among the Greek states themselves. As a result, Philip's Hellenic League can be characterized neither exclusively as a Peace League nor exclusively as a Symmachy League, but in reality it was both: it began as a peace association but, before it was given a chance to operate exclusively on this basis, was expanded into a symmachy association as well. 2) The Hellenic League of Demetrius I of Macedonia was not a new creation but a true copy of the earlier league of Philip so that we can speak of it as a revival or reconstitution of Philip's Hellenic League. A corrollary of this conclusion is that we can now proceed to supplement our knowledge of the constitution of Philip's League with the information which we have regarding the constitution of Demetrius' League and vice versa. 219 pages. $2.85.

HISTORY, MODERN

THE HISTORICAL DEVELOPMENT OF THE CARINTHIAN SLOVENE MINORITY (THE KLAGENFURT BASIN QUESTION)

(L. C. Card No. Mic 58-1104)

Thomas Mack Barker, Ph.D.
University of Minnesota, 1957

Because of physical isolation behind the Karawanken mountain wall and because of an inferior numerical and socio-economic position, the majority -- two-thirds -- of the Carinthian Slovenes (numbering 80,000 in 1910, according to controversial Austrian statistics) were prevented from developing cultural or political unity with other Slovenes. The remnant of the original, almost exclusively Slovene population of the eighth century, they were now subject to the new post-1848 assimilation wave. Yet to Carniolan Slovenes Carinthia was very dear, not only because of "blood" but because of Carinthia's symbolic meaning for the whole Slovene people (who were regarded as "ahistorical" by educated persons). In the nineteenth century historians had begun to penetrate the misty Slovene

past. Slovenes now became aware that their ancestors had had a "prince" who ruled independently (though briefly) and that this sovereign was customarily installed through elevation upon a crude throne. The ceremony took place on the Zollfeld (Gospovetsko Polje), a plain just northeast of Klagenfurt. Even after the Germans' advent in the ninth century and during the original assimilation period, this Slovene language ceremony was long continued (although the duke was now German).

To modern Slovenes, whose gifted historians, opposed by German scholars, continue to probe the subject today, these revelations meant bestowal of "historical" character. Like the Czechs and Croats they could now claim to have had a "state" of their own. Hence, psychologically, possession of the Klagenfurt Basin was important. In 1918-1919 they attempted to seize it from the Austro-Germans, who offered armed resistance. The latter claimed correctly that the Basin's loss would destroy the province's economic-geographic unity. The Peace Conference, influenced by advice of American experts and Italian strategic considerations, decided upon a plebiscite, which was held in 1920 and which resulted in an Austro-German victory.

In the first Austrian Republic the small, indigenous group of Slovene nationalists was not persecuted, but its efforts to improve its own position and to halt the final absorption of the non-nationally minded Slovene majority failed. Since Catholic clergymen had created Carinthian Slovene nationalism, the latter had too narrow an intellectual and sociological basis. Slovenes entering the bourgeoisie or working class were not attracted to a clerical, agrarian group, preferring to vote for one of various German parties. The most vigorous opponents of the Slovene nationalists were the Pan-German liberals who had always been strong in Carinthis (partially due to the existence of Slovene nationalism itself) and who had combatted the former long before World War I (by propaganda and, allegedly, economic pressure). The latter held that the Slovenes were not really Slovenes but a separate, mixed race, whom they labeled in a special, singular sense, the "Windisch" (the traditional German designation for all Slovenes).

With the Anschluss real persecution began, soon resulting in a local partisan movement. In 1945 the Carniolan Slovenes and other Yugoslavs again marched in. They were required to withdraw almost immediately by the West, abducting and murdering 300 non-nationalist Slovenes in the process. In 1946-1947 Yugoslavia officially reclaimed the Basin, but, lacking Allied support, the claims were eventually dropped.

The Austrian State Treaty of 1955 provides minority guarantees. However, they are too inspecific to be useful locally. The nationality conflict continues despite the increasing numerical weakness of the Slovene nationalists (slightly under 7000 votes). Interesting aspects at present are: division of the Slovene nationalists into a Catholic group and "Tito Communist" faction; new, unproportionate Slovene economic strength; and the re-emergence of German nationalist elements under various guises. As previously the main struggle concerns the primary school, the Germans and pro-Germans objecting to the existing, compulsory bi-lingual instruction. 519 pages. $6.60.

THE BRITISH EXPEDITION TO CHARLESTON, 1779-1780

(L. C. Card No. Mic 58-888)

William Thomas Bulger, Jr., Ph.D.
University of Michigan, 1957

During the War of American Independence, the British Government was desirous of establishing a military foothold in the southern colonies where there were reported to be large numbers of Loyalists. In 1776 the British, under Sir Henry Clinton, attempted to seize a post near Charleston, South Carolina, but were repulsed. Additional attempts were made in 1779 and 1780, the latter being successful. Sir Henry also led the 1780 expedition, this time as Commander-in-Chief of the British military forces in North America. At Charleston, the British scored their greatest victory of the entire war, capturing intact the entire American army commanded by General Benjamin Lincoln.

The purpose of this study is to examine the planning and execution of the expedition of 1780, and to relate this campaign to the final outcome of the war. The papers of Sir Henry Clinton in the Clements Library, University of Michigan, Ann Arbor, Michigan, provide an opportunity to consider the southern campaign in detail. The Clements Library also contains the papers of Lord George Germain, Secretary of State for American Affairs, and thus the plans of the government as well as those of Clinton can be studied.

With his great victory at Charleston, Clinton evened the score for the American success at Saratoga in 1777. While the attack on Charleston was taking place, Clinton had a series of quarrels and disagreements with his naval opposite, Admiral Marriot Arbuthnot, and with his own second-in-command, Major General Earl Cornwallis. By the time Charleston surrendered on May 12, 1780, these quarrels had seriously strained relations between Sir Henry and his fellow officers. They subsequently made joint action between the army and navy almost impossible, and impaired co-operation between Clinton and Cornwallis.

The shift in British strategy resulting from the campaign, however, overshadowed these disagreements. Henceforth there were two British armies in the colonies; the northern army commanded by Sir Henry, and the southern army led by Cornwallis. By thus dividing their forces, the British doubled their vulnerability to attack and greatly increased their dependence on sea power, just when the French fleet was becoming a greater threat than ever before.

Their enemies soon took advantage of this situation. In 1781, a Franco-American army, assisted by a French fleet superior to that of the British, cut off Cornwallis and his army in Virginia. The result was Yorktown. But the cause of this British disaster was the initial decision to attack Charleston and to open a southern theater of war.
240 pages. $3.10.

The items following each abstract are: the number of manuscript pages in the dissertation, its cost on microfilm, and the Library of Congress card number. Enlargements 5-1/2 x 8-1/2 inches, 4 cents per page. No postage is charged if check or money order accompanies order.

MARRIAGE AND THE FAMILY IN FRANCE SINCE THE REVOLUTION: AN ESSAY IN THE HISTORY OF POPULATION

(L. C. Card No. Mic 58-1334)

Wesley Douglass Camp, Ph.D.
Columbia University, 1957

The statistical history of marriage formation, marriage dissolution, and family size and composition in France over the past century and a half provides a corrective for popular "theories" of French moral decadence--theories based on the long-term decline in the birth rate. Viewed in the light of historical perspective and the changing social environment, the rates of marriage, divorce, birth, and death in France offer no indication of a weakening of the social fabric. Compared with other Western nations, France was merely the first to experience a trend of declining births, but in the twentieth century she is in the middle range of Western nations in most of the demographic indices, including reproduction rates.

Since the Revolution, marriage and family patterns in France show notable consistency. Only recently, mainly under the impact of two world wars, have these patterns been broken. But even under the impact of war, the family has been resilient. After each war the marriage rate rapidly compensated for the wartime interruption. And recently in the midst of foreign occupation, the birth rate reversed its historic decline, and the average size of completed families increased for the first time in two centuries.

The decline in the French birth rate began a couple of generations before the Revolution and continued down to the early 1940s. The near coincidence of these two revolutions--the political and the "demographic"--led many historians to see a causal connection between them. There probably is none. The causes of the fall in the birth rate must be sought in the social, economic, and ideological forces of the eighteenth century, and in the fall in the death rate which preceded the fall in the birth rate.

Over the past century and a half in France, marriage seems to have grown in popularity: people marry younger, and fewer people remain single in the twentieth century than in the nineteenth. Divorce is much less frequent than in the United States or even in Catholic Austria, but the French rate has risen continuously since the reintroduction of enabling legislation in 1884. (The previous law, enacted in 1792 and repealed in 1816, appears to have been a century ahead of popular demand.) In contrast to the United States, where the modal year of divorce is the third year of marriage, France has had a rather steady pattern in the twentieth century, with a mode in the seventh year of marriage. Regionally there are variations of the order of 1:7 in "nonconciliation" rulings among the French departments, the greatest number being in the urban areas of the Paris basin, the Rhone valley, and the Mediterranean littoral. In spite of the lament of French moralists over the rising divorce rate, more than twice as many marriages are broken by death, during the reproductive ages, as are broken by divorce.

All of the statistics point to the continuing strength of French marital and familial institutions. France no longer faces depopulation. Since World War II, she has higher gross and net reproduction rates than England, Sweden, or Western Germany. In spite of the new level of births, however, large families of five or more children are not increasing. One of the factors in the new level of births is undoubtedly the expanded allowance system of 1939 and 1946, which makes it possible for a worker to almost double his income with the birth of his fourth child. Further study will be needed to determine how the new level of births affects the regional and social-class patterns of marriage productivity. 207 pages. $2.70.

SIBERIA: AN EXPERIMENT IN COLONIALISM, A STUDY OF ECONOMIC GROWTH UNDER PETER I

(L. C. Card No. Mic 58-1283)

Ronald Farinton Drew, Ph.D.
Stanford University, 1958

Traditionally, there has been a tendency to treat Siberia as a conclusive illustration of the military, commercial and administrative policies of the Russian state in its dealings with subjugated peoples of the frontier regions. By adopting such an approach, many writers have produced little more than an institutional interpretation of Russian colonial policy. Naturally such an approach fails to take into consideration the possibility that Siveria itself underwent a change from its late sixteenth-century status of a military frontier to a region which by the eighteenth century had a more broad-based agricultural-industrial-commercial economy. Consequently, a consideration of Siberia as a colony, to be comprehensive, must give regard to the internal development and growth of that territory in the light of internal factors, not see it merely as a reflection of the total colonial policy of the government.

This study attempts to meet the need for such an approach by emphasizing the importance of the economic developments that transpired within the region of Siberia during the era of Peter the Great. The four major phases of the Siberian economy--agriculture, industry, commerce and finance--have been considered with a view to determining the rate of growth of each together with their relative importance to the economy as a whole. The most notable changes and advances were to be found in the expansion of industry, a situation which was fostered by the military activities of Peter the Great. Industries supplementary to those involved in the production of metals and armaments also emerged during the same period from the handicraft stage and shifted their activities to the locale of the mill and the factory, thereby creating additional problems connected with the raising and maintenance of an adequate labor force. In some instances, the lesser industries--including the production of spirits and cloth, glassmaking, tanning, salt-distillation and ship-building--found their continued existence made possible by the increasingly important role that Siberia was coming to play as an intermediary in Russian-Chinese trade relations in the eighteenth century. Moreover, the emergence of several important Siberian fairs--but especially that at Irbit--increased the commercial prestige of that region to such an extent that furs were no longer the sole item of interest for Russian and other foreign traders.

Because local Siberian archival materials are presently available in very limited numbers, it has not been possible to relate the economic growth of the region to possible movements for immediate political and social recognition.

Indeed, it does not seem likely that such ideas were considered relevant until economic maturity had been achieved in Siberia. It has been possible, however, to see the emergence of distinctive economic strata among the populace, each with its own rights, privileges and obligations. Finally, especial emphasis has been placed upon the urban segment of the population by illustrating its relatively rapid growth and recognition within the period covered by this study. 427 pages. $5.45.

THE BRITISH UNDERSTANDING OF THE AMERICAN CONSTITUTIONAL POSITION, 1763-1776

(Publication No. 23,439)

Henry James Halko, Ph.D.
Brown University, 1957

In July, 1948, the William and Mary Quarterly printed an article by Professor Edmund S. Morgan which refuted the view widely held among historians that in the earliest phase of the constitutional debate which preceded the American Revolution, i.e., the period of the Stamp Act crisis, the Americans distinguished between internal and external taxes. Though the colonists never drew such a distinction English statesmen of the 1760's believed that they did, and on that basis Parliament enacted the Townshend duties. Professor Morgan's discovery--that a misunderstanding of the American constitutional position lay behind the act which whipped up the second major crisis leading to the Revolution--raised questions concerning the possible existence of other such misunderstandings which had escaped the notice of historians. The whole constitutional debate between Great Britain and America during the years 1763-1776 needed once again to be carefully scrutinized. This thesis undertook that task.

In establishing the official American constitutional position during the various phases of the debate, the writer relied upon the printed Journals of the several colonial assemblies and of the Continental Congress. These sources were amplified by pertinent correspondence, memoirs, and pamphlet literature. To determine how well the American argument was understood at Westminster, the writer consulted the Parliamentary Debates, the Cavendish Debates, the Journals of the House of Commons, the Annual Register, several Reports of the Historical Manuscripts Commission, the Acts of the Privy Council of England, Colonial Series, and the correspondence and memoirs of such major figures as George III, Chatham, Burke, Grafton, Rockingham, Grenville, North, and Shelburne. One English newspaper, a handful of monthly magazines, and many pamphlets were also examined.

The investigation of these sources revealed that the colonists and Englishmen held different notions concerning charter, natural, and constitutional rights, but these constituted honest differences of opinion. During 1764-1767 a misunderstanding of the American constitutional position did appear when Englishmen supposed the colonists to be distinguishing between internal and external taxes. Actually, the colonial distinction was one between taxation and legislation. Americans conceded Parliament's authority to legislate for them, but they denied her the right to tax them.

Parliament's mistaken view of the American position resulted in the Townshend duties of 1767 which drew fire from the colonies in the form of petitions boldly asserting the right of self-taxation. Because of these petitions, most M.P.'s by late 1768 correctly understood America's constitutional argument. Surprisingly enough, those who were still confused were found among the small body of "the friends of America" in Parliament, the Rockingham whigs and certain of the Chathamites. A fresh series of colonial petitions in 1769 cleared the air, however, and by 1770 all elements in Parliament were aware of the American claim that Parliament's taxing authority did not extend across the Atlantic.

During 1773-1774, the Americans gradually altered their constitutional position. Having argued since 1764 that Parliament could legislate for but not tax them, the colonists in 1774 declared their independence of Parliament by rejecting her legislative authority. The American concept of empire was a federative one in which the coordinate parts were held together by ties to a common monarch. Such language was political heresy not only to the North ministry, but to America's whig supporters in Parliament. Yet the Chathamites and the Rockingham whigs continued to serve as champions of America. Chatham was able to do so by shutting his eyes to the fact that he and the colonists no longer agreed on the nature of Parliamentary authority. Bowing to expediency, the Rockingham whigs publicly maintained, in the face of the facts, that the Americans were not assaulting Parliament's supremacy. To have argued otherwise would have cost the Rockingham whigs their political existence, for the one factor which kept them alive as an opposition party was their steadfast defense of America. They could not afford to surrender that issue.

In the opinion of George III and his ministers, the rejection of Parliament's sovereign authority made rebels of the colonists, although the Americans still considered themselves His Majesty's loyal subjects. When George III advocated the use of force to bring them to their senses, the Americans decided in 1776 that they could do without both king and Parliament.

The great tragedy of the decade preceding the American Revolution does not lie in a lengthy listing of incidents which involved a British misunderstanding of the American constitutional position, for except in the matter of internal and external taxation at the very beginning of the dispute, British statesmen accurately comprehended the American claims. Rather, the pity is that British officials throughout the period 1764-1776 never recognized the level of political maturity America had reached, that they lacked the vision to appreciate a new concept of empire, and that a deep-rooted suspicion caused them to consider America as waging a relentless campaign for independence. These shortcomings cost Great Britain her colonies in America.
183 pages. $2.40. Mic 58-4827

The items following each abstract are: the number of manuscript pages in the dissertation, its cost on microfilm, and the Library of Congress card number. Enlargements 5-1/2 x 8-1/2 inches, 4 cents per page. No postage is charged if check or money order accompanies order.

THE SAMURAI CLASS DURING THE EARLY YEARS OF THE MEIJI PERIOD IN JAPAN, 1868-1882

(L. C. Card No. Mic 58-925)

Harry Harootunian, Ph.D.
University of Michigan, 1957

This study is concerned with the problem of finding out what happened to the members of the former feudal class, the samurai, in the years after 1868 when they were stripped of traditional privileges and means of support. Since the samurai were the most important class in Japan before the Restoration of 1868, it seemed natural to study them in a circumstance where they were forced to abandon a traditional way of life in order to find a new place in an emergent industrial society. By studying this process of samurai absorption, we have been able to discover something very elemental in regards to the social organization of modern Japanese society.

We have divided the problem of samurai absorption during the Meiji period into two levels of investigation, the national and the local. At the national level, the central government, between the years of 1868 and 1882, developed a program which provided the samurai class with opportunities to take up new forms of employment and means of support. While the majority of the class eagerly responded to the new economic opportunities the government was offering them, a small element within the class expressed discontent to the new government's policies. This discontent produced two types of samurai opposition to the government in the decade following the Restoration. The first type of opposition was felt in the samurai rebellions in Saga, Fukuoka, Kumamoto, Hagi, and Satsuma. These revolts were attempts by samurai groups to exert pressure on government policy, but they never embraced more than a fraction of the entire class. The second type of samurai opposition to government policy was found in the development of political societies. A group of discontented samurai, rather than pursuing a course of rebellion, organized political societies that pressed for the establishment of "popular rights" in Japan. Although these efforts came to be known as the "democratic movement" they were merely another form of samurai opposition to the government's policies and reforms. The movement for "popular rights," like the samurai revolts, never tapped more than a fraction of the entire class.

Samurai opposition on the national level, in short, was of an impermanent nature. Appearing in the early 1870's, it reached its zenith by the end of the decade. Since both forms of samurai opposition had little effect in capturing the support of the major portion of the class, they were successfully dealt with by the central government.

Since most of the central government's policies and reforms concerning the samurai were in fact worked out at the local level, an examination of the samurai at this level has furnished us with a detailed picture of how these reforms and policies actually affected the class. In a case study of the samurai members of the Okayama clan, we have been able to discover, with some precision, what kind of jobs and means of support these ex-retainers assumed after 1868. On the basis of the findings in the case of Okayama, supplemented by material from other areas, it has been estimated that nearly one-third of the class found their way into administrative, educational, military, and police work.[1] The remaining two-thirds, however, were obliged to seek security in the new economic opportunities which were offered them by the central government. As a result, the largest bulk of the class found new means of employment and livelihood in agricultural and industrial occupations.

In sum, the samurai class in Japan, after being stripped of traditional social and economic privileges, were absorbed, in an orderly fashion, into the "new" society. Rather than oppose, en masse, the reforms which deprived them of their feudal privileges, they chose to ride with the times, to join the new government, or to seek security in the new economic opportunities which were offered them. They became, in short, the backbone of Japan's modern civil, military, and police bureaucracy, and of her industrial management and labor force. The formation and rapid development of a modern industrialized Japanese society was accomplished as a result of the tools, training, education and experience brought to it by members of the former feudal class. 226 pages. $2.95.

OUTLAWING THE SPOILS: A HISTORY OF THE CIVIL SERVICE REFORM MOVEMENT, 1865-1883

(L. C. Card No. Mic 58-1341)

Ari Arthur Hoogenboom, Ph.D.
Columbia University, 1957

American agitation for civil service reform had its real beginning in 1865. In December of that year, Representative Thomas A. Jenckes introduced a bill which was a prototype of the Pendleton Act. Its cardinal feature was that appointments were to be based on merit as determined by competitive examinations open to all. At first, the measure drew little attention in Congress or in the nation's press, but--with the aid of an obscure government clerk, Julius Bing--Jenckes stimulated public interest in reform through reports, articles, and speeches. Among the early influential converts to civil service reform were Edwin L. Godkin, editor of the Nation, and George William Curtis, editor of Harper's Weekly. Jenckes also received considerable support from the so-called "better" element of society, which was snubbed by President Andrew Johnson in his appointments.

Reformers had great hopes when Ulysses S. Grant was elected President. They were disappointed until Grant tardily called for reform after a setback in the election of 1870. The following year--over the protests of Grant's closest friends--Congress established a Civil Service Commission to prescribe rules for examining applicants. Grant at first supported the commission and applied its rules to a part of the civil service. Horace Greeley's candidacy in 1872, however, divided reformers and subjected them to ridicule. Soon after the election, Grant made exceptions to the rules and finally, in 1875-- since neither Congress nor the public seemed to care--abandoned civil service reform.

Complete defeat led reformers to reunite. Although they were unsuccessful in securing Benjamin H. Bristow's nomination in 1876, most reformers were satisfied with Rutherford B. Hayes and worked for his election. Hayes vacillated between spoils and reform methods, but reformers felt some gains were made under his administration;

competitive examinations proved feasible in the Interior Department and in the New York Customhouse and Post Office.

The pace of the reform movement quickened. Reformers rejoiced at James A. Garfield's nomination but were bitterly disappointed when he abandoned the ground Hayes had taken. This reversal led reformers to organize pressure groups in 1880 and 1881. Lawyers, editors, clergymen, professors, and businessmen whose interests were mercantile and financial rather than industrial provided the driving force of the civil service reform movement. Analysis of reform leaders questions Matthew Josephson's hypothesis that businessmen were the mainspring of the reform movement.

Garfield's assassination was providential for the reform movement. Public opinion was thoroughly aroused against the spoils system, and reformers did not allow it to subside. Throughout 1882, they pressed for the passage of the Pendleton bill--which they had written--through petitions, articles, and speeches. Nevertheless, congressmen remained adamant until after the severe Republican setback in the election of 1882. A chastened but unconverted Republican Congress in its lame duck session passed the Pendleton bill.

After securing national legislation, the civil service reform movement declined. State civil service laws passed in New York and Massachusetts were soon virtually ignored, and laws proposed in other states were not passed. Presidents, however, steadily expanded the federal classified list to protect their partisans from mass removal when another party gained control. Paradoxically, politicians extended the classified service while the reform movement languished. Advances of the merit system on state and municipal levels awaited the rise of the Progressive movement. 463 pages. $5.90.

JEFFERY, LORD AMHERST, BRITISH COMMANDER-IN-CHIEF, 1778 TO 1782

(L. C. Card No. Mic 58-1419)

Henry Peter Ippel, Ph.D.
University of Michigan, 1957

The object of this study is to analyze Lord Amherst's dual military and political role as Commander-in-Chief of the forces in Britain during the era of the American Revolution. The analysis, based largely upon his papers deposited in the British Public Record Office, clarifies another element in the internal structure of British government in the eighteenth century, and the problems of home defense and internal disturbances which complicated Britain's war effort.

In recognition of his successful command in America during the Seven Years' War, Jeffery, Lord Amherst, (1717-1797), was elevated to the position of Commander-in-Chief from 1778 to 1782. The military forces gathered in England as a reservoir for overseas reinforcements and to protect Britain's shores from enemy invasion were under his command. Promotion, discipline, troop deployment, defense strategy, as well as the quelling of domestic violence, were his responsibility.

The political features of his position required a close relationship with King George III, the Cabinet, Parliament, and government departments. He was the King's alter ego and military adviser. As a member of North's cabinet, he made policy; he advised administrative departments on military affairs. The Opposition attacked him both in and out of Parliament; by exposing the deficiencies of Amherst's command, they hoped to embarrass North's administration.

Amherst's military role was successful. His command justified the confidence of his officers and men as well as his colleagues in government. Under his direction, Britain's coastal defenses were not breached or tested, and the domestic disturbances were subdued. His political role was less successful. He was apolitical, lacked strong leadership qualities, and limited himself largely to military matters. He failed or refused to manage the Army interest in Parliament, defend administration policy, and use his high position in government and the Army for political purposes. In consequence, his position in George III's personal government was obscured by the King and the other ministers. 247 pages. $3.20.

RUSSIAN EXPANSION INTO THE CAUCASUS AND THE ENGLISH RELATIONSHIP THERETO

(L. C. Card No. Mic 58-949)

Norman Luxenburg, Ph.D.
University of Michigan, 1957

The primary purpose of this work will be: to develop a true understanding of England's actual relationship to Russian expansion into the Caucasus. The activities of English freebooters in the Caucasus were a source of misunderstanding between Russia and England and were largely responsible for seriously straining relationships between the two powers during the 1830's.

Before English activity can be properly evaluated, it is essential, however, to gain further insight into the nature of the Russian expansion and the reasons behind the difficulties Russia encountered. For this purpose the two chapters following the introduction will deal primarily with the causes and origins of the Russian wars with natives of the Eastern and Western Caucasus and the origins of English interest in this general area, prior to 1829.

In that year, Russia, having brought the wars with Turkey and Persia to successful conclusions, was able to concentrate virtually the full weight of her Caucasian forces against the mountaineers who still resisted. The subjugation of these people proved to be a much more difficult task than could have been imagined. For the next thirty-five years the Russians found themselves involved in a long series of wars, which not only prevented them from exploiting the rich resources of the area, but also served to divert much of their strength from the other areas, where their presence may have lent weight to their diplomatic negotiations.

The demands of the Caucasian fighting on the Russian military establishment increased constantly throughout the 1830's, and by 1845 the Russian forces in the Caucasus were increased to 250,000 men in an attempt to bring these sanguinary struggles to a conclusion. To the Russians, a significant explanation for their difficulties seemed to lie

in the presence of English freebooters in the Caucasus during the mid-1830's.

The very presence of these Englishmen assumed such an importance that relationships were considerably strained between the two countries, and exaggerated impressions of England's activities have been handed down to posterity. England, and the English government, in fact, are accused of countenancing, and even encouraging, the freebooters' activities.

Chapters IV and V are concerned primarily with an investigation based largely on memoirs, British Foreign Office Reports, and official Russian reports of English activity in the Caucasus from 1829 to 1840, at which time reports of English activity in the Caucasus cease. Chapter VI is a discussion of events in the Caucasus from 1840 to the outbreak of the Crimean War, at which time English interest in the Caucasus was again aroused. The final chapter is concerned with the English connection with the Caucasus from the outbreak of the Crimean War to the definitive Russian conquest of the Caucasus.

Several general conclusions can be drawn from this study. 1) The Russian wars with the Caucasian natives began before England showed any interest in the area. 2) There were English freebooters in the Caucasus in the 1830's apparently instigating the mountaineers against the Russians. However, they were neither supported nor encouraged by the English government. 3) Neither England nor English agents had any connection with the Russian wars in the Eastern Caucasus. 4) Following the Crimean War England completely abandoned any hopes for Caucasian or Circassian independence. 247 pages. $3.20.

THE MISSION COMPOUND IN MODERN CHINA: THE ROLE OF THE UNITED STATES PROTESTANT MISSION AS AN ASYLUM IN THE CIVIL AND INTERNATIONAL STRIFE OF CHINA, 1900-1941

(L. C. Card No. Mic 58-1453)

Gladys Robina Quale, Ph.D.
University of Michigan, 1957

The purpose of this study is to assess the significance for China of the safety found in United States Protestant missions by Chinese subjects during periods of warfare between 1900 and 1941.

Part One describes the development of the treaty clauses under which United States Protestant missions existed in China, together with their modification in practice; the growth of the prestige granted by Chinese to United States Protestant missions because of the protection given them by Chinese and American officials; the attempt made by Chinese to use that prestige for their own purposes; and the measures taken against this practice by United States Protestants in the years preceding 1911.

Part Two delineates the rise and decline of the use of mission enclosures as asylums during the rebellions, wars, and revolutions of 1911 to 1928. In the first part of this period all who were inside the walls of United States Protestant missions were left unharmed, for experiences in the years treated in Part One had discouraged the Chinese from injuring foreigners and what pertained to them. The rise of modern nationalism and the influence of Soviet propagandists in the renascent Kuomintang diminished the position of power held by Westerners in China until approximately 1925. Since the increased anti-foreign activities of the mid-1920's provoked no response on the part of the West comparable to the international punitive expedition of 1900, armed Chinese ceased to leave unmolested those of their fellow-countrymen who fled to mission compounds.

Part Three depicts the revival of the inviolability of United States Protestant missions in the struggle between Japan and China. From 1937 to 1941 mission properties were again able to shelter Chinese in combat areas, for they belonged to citizens of a powerful nation which was not yet an active participant in the Far Eastern conflict. However, the entry of the United States into World War Two and her subsequent relinquishment of the treaty-granted privileges held in China by her citizens ended the ability of United States Protestant missions to offer asylum because of their foreign ownership.

The following conclusions can be drawn from the study. 1) The capacity of United States Protestant missions to harbor Chinese during wartime depended upon the degree of awe felt for Western power by those who were disturbing the peace of China. 2) The effectiveness of the shelter given to Chinese by United States Protestant missions therefore varied with the physical security accorded by the Chinese to Westerners in general, which in turn was dependent on the relative strength of China and the West. 3) The recognition by missionaries of the close association between the safety of their enclosures and China's fear of retaliation by Western governments for any harm done to foreigners forced upon United States Protestants a continual struggle with the dilemma of whether or not they ought to use their connection with the United States for the preservation of Chinese lives. 4) United States Protestants therefore exerted themselves to avoid favoring one class or group over another in the protection they afforded to Chinese. 5) The realization by Chinese of the relationship between Western might and mission inviolability was a factor in the resentment against foreign privileges which led in the 1920's not only to China's insistence upon treaty revision but to the success of the Kuomintang. 6) During the war with Japan, Chinese accepted the special position held by United States Protestant missions because their humanitarian services assisted the nation and its people against a foreign invader. 321 pages. $4.15.

A HISTORY OF ADMINISTRATION IN BIZEN HAN

(L. C. Card No. Mic 58-991)

Gaston Joseph Sigur, Jr., Ph.D.
University of Michigan, 1957

The purpose of this study is to examine the administration of a feudal fief or Han of the Tokugawa period (1600-1868) in Japan in order to ascertain the degree of centralization achieved by its officials. The fief selected for study was that of Bizen (modern Okayama). Bizen Han was chosen for three reasons. 1) It was typical of the larger fiefs of Tokugawa Japan. 2) The original documents of the Ikeda family which ruled Bizen from 1632 to 1870 were available to the author. 3) The first daimyo of the fief, Ikeda Mitsumasa (1632-1682), is recognized by Japanese

scholars as one of the three greatest administrators of the Tokugawa period. The importance of this study is two-fold. 1) It describes for the first time an important, but neglected area of Tokugawa administration.)2) It reveals the bureaucratic structure upon which modern Japanese local government is based.

The dissertation begins with an introduction which traces the history of Japanese administration, in general, from the early years after the formation of the Japanese state to the Tokugawa period. Particular emphasis is placed upon the growth of the daimyo, the ways by which the Tokugawa authorities exercised control over these lords, and the almost complete administrative independence over their individual fiefs which the daimyo enjoyed. With this as a background, the study turns to the Ikeda feudal family and describes the means by which they acquired the important Bizen fief and the structure of fief administration established by Ikeda Mitsumasa and his advisers in Bizen. The main body of the study is devoted to the three major areas of administration within the Han: the central, the rural, and the town bureaucracies. The central bureaucracy dealt with the affairs of the daimyo and his vassals and with the overall policies of the fief. The rural administration was concerned with the control of the villages and the peasants. The town administration was the governing authority of the castle town of Okayama and for the townspeople, not samurai, who lived there.

Several conclusions have been reached as a result of this research. 1) The Han administrative structure designed by Ikeda Mitsumasa and changed little thereafter during the Tokugawa period, was built upon the foundation of military-aristocratic ranks into which the ruling class, the samurai, were divided. 2) It was a stable, hierarchical institution in terms of personnel, offices, and functions. 3) There was no separation of powers, so essential in a modern state, but there did exist a delineation of authority and functions which allowed for the growth of a strong bureaucracy. 4) The centralized bureaucracy which developed in the Han areas of local autonomy became more civil than military in nature as time went on. 5) With the overthrow of the Tokugawa in 1868, the centralized administrative structure of the Han was utilized by the new Meiji government, first of all, as the means by which its authority was initially maintained, and, secondly, as a base upon which later local government rested. 189 pages. $2.50.

ALBERT B. FALL AND THE TEAPOT DOME AFFAIR

(Publication No. 16,944)

David Hodges Stratton, Ph.D.
University of Colorado, 1955

Supervisor: Assistant Professor Robert G. Athearn

Albert Bacon Fall had extensive experience as a public office holder in territorial New Mexico and nine years of service in the United States Senate when his Senate associate and close friend, President Warren G. Harding, appointed him to the Cabinet in 1921. As a prospector, practical miner, and mining investor in the Southwest and across the border in Mexico, he had been developing the natural resources for forty years. Fall's belief in the unrestrained and immediate disposition of the public lands was as typically western as his black, broad-brimmed Stetson hat and his love for horses. Consequently, it should not have been surprising that while Secretary of the Interior, he negotiated agreements with two oil magnates, Harry F. Sinclair and Edward L. Doheny, for the exploitation of the Teapot Dome Naval Oil Reserve in Wyoming and a similar reserve in California.

Later a Senate investigating committee revealed that Fall had received large sums of money from the two oilmen. The naval reserve inquiry placed the New Mexican in an extremely disadvantageous position. In the presidential election of 1924 the Republicans needed a scapegoat for their oil sins; Fall was the most likely prospect. The Democrats realized that the so-called Teapot Dome scandal was a choice campaign issue, and they nourished it through the elections of 1924 and 1928. Because of this political attention and the lengthy civil and criminal litigation which followed the Teapot Dome investigation, the naval oil controversy was kept alive for almost a decade. Again Fall became the scapegoat. He was the only defendant convicted in the criminal cases resulting directly from the Senate inquiry of 1923 and 1924. All of the transgressions associated with the oil scandal, and to a certain extent all of the iniquity of the Harding administration, were imputed to him. Old and ill, the former Secretary of the Interior went to prison in 1931 for accepting a bribe. The two oil millionaires went free.

As a result of the Teapot Dome affair, Fall was broken in health, reputation, and finances. No matter what explanations were presented, his acceptance of the money from the two oilmen while holding a public trust was reprehensible. He was an astute politician and must have known the possible implications of these financial arrangements. His greatest mistake, however, was writing a letter to the Senate investigating committee in which he declared that he had never received any funds from either Doheny or Sinclair. On the other hand, if he had wanted to sell the leases for personal gain, it seems unreasonable that he would have taken $400,000 for them when the price for bribery should have been at least $2,000,000. It appears likely that Doheny, Fall's friend of frontier days, would have loaned him the $100,000 on which the bribery conviction was based regardless of the leases. Also because of his attitude toward the natural resources, and for this reason alone, the New Mexican no doubt would have turned over the reserves to Doheny and Sinclair, or to some other representatives of private enterprise.

The disapprobation directed at Fall has made him one of the most controversial figures in American history. An attempt was made by the writer to present this colorful westerner as a personality rather than as some vague, evil influence.. Principally from Fall's personal papers his side of the naval oil issue is given and compared with the more critical views of his activities. Obtaining a sound evaluation of the situation from a mass of conflicting statements and evidence was a major difficulty.

537 pages. $6.85. Mic 58-4828

DUKE ERNST OF BAVARIA AND THE TERRITORY OF SALZBURG, 1540-1554

(L. C. Card No. Mic 58-1364)

Felix F. Strauss, Ph.D.
Columbia University, 1957

Duke Ernst (1500 - 1560) was the third and youngest son of Albrecht IV of Bavaria. Subsequent to this Wittelsbacher's death his older sons, Wilhelm IV and Ludwig (X), ruled Bavaria jointly--in violation of the recently introduced law of primogeniture. Taking advantage of the broken law Ernst laid claim to one third of Bavaria, a claim which his older brothers rejected with determination. Instead, they tried (unsuccessfully) to persuade Ernst to take holy orders and (successfully) to obtain for him ecclesiastical offices and territories to administer. Thus, besides drawing on several minor benefices, Ernst was administrator of the bishopric of Passau, 1517 - 1540.

The death of Cardinal Matthias Lang, archbishop of Salzburg, in 1540 made it possible for the Wittelsbachers to secure that metropolitan see for Ernst in accordance with a secret agreement concluded between the cardinal and the dukes during the Peasant War in 1525. The Salzburger Cathedral Chapter duly elected Ernst to the office of archbishop. However, as the Duke was unwilling to abandon his lay status, papal approval of the election was necessarily coupled with a dispensation. Limited to ten years, the curial dispensation was renewed for four more, after which time--under the pressure of the reform spirit of the Council of Trent--Ernst chose retirement rather than holy orders. His title "Archbishop-Confirmed" rather than "Archbishop" betokens that he was, in fact the administrator of the archbishopric.

The dissertation is so organized that the political and administrative and the social and cultural events during Ernst's fourteen years in Salzburg, outlined respectively in Parts One (Chs. I - III) and Three (Chs. VII - X), form a framework for the core of the study, Part Two (Chs. IV - VI), in which the secular-minded Duke's mercantile and industrial enterprises are discussed and analyzed. For, in the age of early modern capitalism, he belonged to that group of aristocratic entrepreneurs whose significant contributions to our money economy have been but recently recognized.

Ernst's interests were focused on commercial enterprises; his talents were directed toward their organization and management. An expert in mining, he employed his managerial abilities to the advantage of the Salzburger territory's economy which, during the sixteenth century, was dependent on the marketing of the output from its gold, silver and copper mines. His concern--as reflected in his correspondence, orders and directives--extended from mining to minting, from raw ores to finished goods, from overhead to the hiring of workmen to sales contracts abroad, from road construction to transportation, from food supplies to price quotations on foreign markets, from accurate bookkeeping to punctual rendition of accounts. His concern extended from the broad economic needs of the territory to the minutest details of his own widely scattered industrial and mercantile ventures. While Ernst was able to draw on the estabiished hierarchy of administrative officials and mining functionaries, a special group of personal retainers--called "roving agents" in this study--dealt with his private business affairs.

The dissertation is equipped with three maps depicting, respectively, the principal towns, rivers, and passes, and the administrative subdivisions of the Salzburger territory in the sixteenth century, as well as the location of mines and mining works in which it is known that Ernst held shares. An appendix contains a genealogical table and brief notes on monetary units, weights and measures, and a list of mining terms relevant to Salzburg of the period. Reproductions of contemporary portraits, views of the town and a map of the territory of Salzburg, and a directive of Ernst serve as illustrations. 405 pages. $5.20.

WILLIAM STITH, HISTORIAN OF COLONIAL VIRGINIA

(L. C. Card No. Mic 58-1097)

Toshiko Tsuruta, Ph.D.
University of Washington, 1957

William Stith (1707-1755) is not a well-known figure but was, nevertheless, one of the leading intellectuals of eighteenth-century Virginia. After his education at the Grammar School of William and Mary College, he went to Queen's College, Oxford, where he received his Bachelor's and Master's degrees. His career was spent chiefly as educator and clergyman--as Master of the Grammar School of William and Mary, as rector of the Henrico Parish, as chaplain to the House of Burgesses and as the third president of William and Mary College.

Among the various occupations of his career, what gave Stith a lasting stature as a distinguished intellectual leader of colonial Virginia was his History of the First Discovery and Settlement of Virginia, published in 1747. The work is not only one of the three major histories of Virginia published during the colonial period (together with Captain John Smith's General History and Robert Beverley's History and Present State of Virginia) but also by far the best and the only scholarly history of the colony written down to his day.

The writing of scholarly history had been one of the characteristics of English (and European) historiography since the Renaissance. Stith's acquaintance with such histories, chiefly through his reading, coupled with the accessibility to him of a number of original sources bearing upon the early history of Virginia, made him desire to write a detailed, scholarly history of his native land equal in scholarship to some of the scholarly histories written in England. In this sense Stith represented both the growing intellectual self-consciousness of the Virginians and the degree of learning and sophistication that the intellectual life of the colony had reached by his day. For by Stith's time Virginia could produce a scholar capable of engaging himself in a scholarly pursuit of this kind, and it could furnish him with enough tools to work with; the scholar, in return, went at his work with great learning, indefatigable industry, and a dedicated sense of mission to serve and honor his native land, Virginia.

Stith's work was intended to cover, in several volumes, the entire history of Virginia down to his own time. He completed only one volume. His election to the presidency of William and Mary College in 1752 diverted his attention from his writing, and his death in 1755 put a final end to

his enterprise. As it stands, the History covers the years from the beginnings to 1624. It is a careful and highly accurate "erudite" narrative, based almost entirely upon original sources.

Stith's History also betrays his practical desire for expressing his own political philosophy and thus educating his fellow Virginians in the face of the immediate political needs of the day. Stith's political stand was a somewhat belated colonial restatement of that of the English Whig of the early eighteenth century, supporting the Protestant succession against the "tyranny" of Jacobite pretenders and asserting the natural rights and liberties of Englishmen. This viewpoint is clearly expressed in his History, through his severe censure of the conduct of the Stuart king, James I, and through his ardent advocacy of the "rights of Englishmen" which he considered as guaranteed in the original charters of Virginia. Stith's argument was directly in line with that used in the famous "pistole fee" controversy of the 1750's between Governor Dinwiddie and the Virginians, to which Stith contributed his famous toast for "liberty, property, and no pistole." Stith's History is a typical expression of the ideology of mid-eighteenth-century Virginia, while basically it remains a factual, scholarly history. 228 pages. $2.95.

NEW HAMPSHIRE'S JOHN SULLIVAN

(L. C. Card No. Mic 58-1367)

Charles Park Whittemore, Ph.D.
Columbia University, 1957

John Sullivan, a man of humble origin who yearned for recognition and success, emerged as a leader in his native New Hampshire before the American Revolution. A lawyer by profession, he was in the front ranks of those who wanted independence. Upon the outbreak of hostilities he entered the army as a brigadier general, and later earned promotion to major general. His war career, 1775 to 1779, was marked by bravery but bad luck. He led the tattered army from Canada in 1776, and was blamed womewhat unfairly for the British flanking movement during the Battle of Long Island. Captured during this battle, Sullivan went to Congress as an emissary from Lord Howe who wished conciliation. In this role Sullivan was dupe.

After his exchange he fought bravely at Trenton and Princeton, and during the summer of 1777 led an imaginative but unsuccessful raid upon Staten Island. In September he had command of the right wing at the Battle of Brandywine. Once more his wing was turned by the British, but he should not be entirely blamed for the collapse of intelligence. Still enjoying Washington's confidence, Sullivan received command in Rhode Island, and during the summer of 1778 hoped to dislodge the British from Newport with the assistance of the French. The Comte d'Estaing, however, after his fleet had been battered in a storm during an encounter with the British, sailed to Boston. This irked Sullivan and his criticism of the French momentarily strained the alliance.

In 1779 Sullivan had command of a punitive expedition against the Six Nations in New York. Although overcautious, he carried out the assignment with dispatch. Claiming poor health, Sullivan resigned from the army in November, 1779. Although he hoped to have his resignation made temporary, Congress chose otherwise. His complaining nature and criticism of the Board of War had gained him too many enemies.

From September, 1780, to August, 1781, Sullivan was again in the Continental Congress. His actions indicate that he had little faith in that body's ability to serve as a deliberative group. He sought to bring stability to the currency, and approved of reorganizing the administrative departments. In his own mind he was sure that an overhauling of governement was necessary. In foreign matters he followed the French lead, mainly because his inclination led him in that direction, but possibly because he inexcusably had accepted a loan, in effect a subsidy, from Luzerne. The British made overtures to him, but the evidence, although contradictory, indicates that Sullivan never wavered in his loyalty.

Upon his return to New Hampshire, Sullivan became an important political figure. He had a politician's talents and always remained popular with the people. He may be grouped with the nationalists of the post-war years. As President of the state he sought stability and order. He suppressed the paper money riot in 1786 and gave vigorous support to the United States Constitution during the fight for ratification. His loyalty to the federalist cause was rewarded by Washington who appointed him to the Federal District Court, but illness prevented his serving in that post for long.

Throughout his lifetime Sullivan had shown a conceited, pompous side. A hypersensitive man, he constantly felt that he was being slighted. This may explain his excessive drinking which in turn probably led to his early death in 1795 in his fifty-fifth year. In spite of these weaknesses of character, Sullivan had served his country with devotion, and emerged as an important leader in New Hampshire.
649 pages. $8.25.

A STUDY OF CERTAIN FACTORS RELATED TO THE VOCATIONAL ACTIVITY OF HOME ECONOMICS-EDUCATION GRADUATES

(L. C. Card No. Mic 58-1152)

Mary Helen Haas, Ph.D.
University of Minnesota, 1957

Analysis was made of certain factors underlying the presence and intended persistence of Home Economics-Education graduates of the University of Minnesota in two vocational roles. Each graduate was viewed as being prepared to perform either the role of high school home economics teacher or the role of homemaking as her primary vocational role.

It was hypothesized that:

1. When two vocational roles are available, the individual will perform the one toward which the most favorable attitude is held.
2. In comparison with attitude toward the alternative role, favorableness of attitude toward the current role is directly related to stated intention to persist in the role.
3. Commitments to current vocational role are directly related to stated intention to persist in the role.
4. Perceived adequacy of income from current vocational role is associated with stated intention to persist in that role.
5. The degree of satisfaction with a vocational role is directly related to stated intention to persist in the role.

Measurement of favorableness of attitude toward each of the two vocational roles was secured through the use of two Likert-type attitude scales containing sixteen items each. These scales, developed especially for the study, were shown to have satisfactory reliability and validity.

A mailed questionnaire was sent to a one-third random sample (N=162) of the graduates of the Home Economics-Education curriculum of the University of Minnesota during the past twenty years who still reside in Minnesota. Eighty-four per cent usable returns were secured.

The findings indicate:

1. There is support for the hypothesis that comparative favorableness of attitude toward the alternative vocational roles is directly related to vocational role being performed.
2. For the homemakers, there is support for the hypothesis that comparative favorableness of attitude toward the alternative vocations is directly related to stated intention to persist in the current vocation. For the teachers, the hypothesis remains in doubt.
3. For the homemakers, perceived adequacy of income is associated with stated intention to persist in current vocational role. For the teachers, the hypothesis remains in doubt.
4. The following hypothesized associations with stated intention to persist in current vocational role remain in doubt:
   a) Commitments to current vocational role;
   b) Satisfaction with current vocational role.

This study makes a contribution to knowledge concerning factors influencing vocational choice of adult women who are prepared to serve in more than one vocational role. The development and validation of scales measuring favorableness of attitude toward high school home economics teaching and homemaking provides tools which should prove fruitful in future research and should be of assistance in planning action programs designed to bring Home Economics-Education graduates back into the teaching profession. It should be of assistance in planning instruction for the development of the desired attitudes toward high school home economics teaching among students in the Home Economics-Education curriculum.

259 pages. $3.35.

THE HOMEMAKING PROBLEMS, SATISFACTIONS, AND GOALS OF RECENT HOME ECONOMICS GRADUATES AND THEIR IMPLICATIONS FOR THE COLLEGE CURRICULUM

(Publication No. 25,447)

Elizabeth Charlotte Hillier, Ph.D.
The Ohio State University, 1952

The dissertation is a part of an extensive plan for curriculum evaluation in the School of Home Economics at the Ohio State University. Three major programs were originally included in this plan, a departmental self-survey, a survey of the curriculum's effectiveness with students, and a survey of the effectiveness of the department's graduates. The present study is concerned with one aspect of the latter program. It is in the form of a follow-up study of young married graduates.

Three types of behavior which an effective homemaker might exhibit were sampled, the recognition of problems, the recognition of satisfactions, and the establishment of goals. Evidence of the recognition of problems was sought in two ways. First, by means of a check list containing areas of homemaking in which problems may occur, and, second, through an analysis of homemakers' narrative reports about problems of concern to them.

Evidence of the recognition of satisfactions was also sought through an analysis of narrative reports which describe areas of homemaking found to be most satisfying. To secure evidence of goals held, a paired-comparisons

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instrument was devised. In addition, the homemaker was asked to describe in her own words the homemaking goals toward which she was working.

There were certain hypotheses and assumptions which guided the choice of the techniques used in the study. The first was that the types of homemaking problems and satisfactions which are of concern to the young married graduates and the kinds of goals which they have for their homes may form one basis for judging the effectiveness of the home economics curriculum and may have implications for the core of required courses. A second hypothesis was that expressed problems of homemakers will be centered around the area of management. The third hypothesis was that the types of problems of concern to homemakers and the satisfactions they find in homemaking will reflect the goals toward which they are striving.

A number of assumptions were necessary in order to proceed with the plan for testing the hypotheses. First, it was assumed that the effectiveness of a curriculum may be discovered through a study of its graduates. A second assumption was that effectiveness in homemaking, a goal of the home economics curriculum, may best be evaluated through a study of the married graduates now engaged in homemaking.

A third assumption was that a sampling of the types of problems, satisfactions, and goals of homemakers may be secured through written replies to questions. A fourth assumption was that a qualitative analysis of narrative reports, elicited by questions under conditions that permitted free discussion, would reveal underlying themes and shades of meanings suggestive of basic problems, satisfactions, and goals. The fifth assumption was that interviews of a portion of the group would serve as a means for checking the reliability of the findings revealed through the written replies.

The sixth, and last, assumption was that the problems, satisfactions, and goals of recent married graduates would be of concern to home economics faculty members, particularly those teaching in the core of required courses that deal with the basic aspects of home living.

Procedures Used in the Study

The Group Studied. The group from which the participants were drawn was composed of those home economics graduates of the years 1946 through 1950 who were married and had taken their entire college program in the School of Home Economics at the Ohio State University. The total number in this group was one hundred and fifty-seven. Of this number 83, or 53 per cent, replied to both forms.

The Questionnaire. The first form sent was a questionnaire dealing with homemaking problems and satisfaction. The first part asked for general information concerning the graduate.

The second part dealt with homemaking problems. A list of homemaking areas was provided so that the homemaker could indicate, by underlining and circling, the areas in which her problems occurred and those which contained the problems of greatest concern to her.

The last question in Part II asked the homemaker to describe the problems which concerned her most. These descriptions provided material for a qualitative analysis from which the basic types of problems of homemakers were to be discovered. Previous examinations of such descriptions from a pilot study had shown that key statements made by homemakers revealed certain basic types of problems that were common to groups of homemakers and to different areas of homemaking.

The third part of the questionnaire contained a question dealing with the satisfactions of homemakers. When setting up the form for the questionnaire, it seemed desirable to prevent, if possible, an overemphasis on problems and also to give the homemaker an opportunity to state which phases of homemaking were particularly enjoyable to her. The descriptions given of satisfactions were also to be analyzed for basic types common to the group as a whole.

The fourth part of the form asked the group, first, how they felt their own college home economics training had been of greatest help to them as homemakers, and, second, how it could have been of help but was not. Again, narrative reports were called for, which were to be analyzed in the same way as those for problems and satisfactions. Before the questionnaire was set up in the final form, it was pretested with a group of young married home economists.

Inventory of homemakers' goals. After a period of two months a second form was sent to those who had returned the questionnaire. This second form dealt with homemakers' goals. It was considered important to have a period of time elapse between the filling out of the two forms. There was a possibility that if the two forms were filled out simultaneously the homemaker's choice of goals would be too strongly influenced by the problems she had described, thus preventing a true picture of her goals. A false relationship between problems and goals might thus be established.

The form, a paired comparisons instrument, consisted of pairs of statements representing goals. The goals represented by the statements, as well as the statements used, were first judged by a jury selected from the fields of home economics, psychology, sociology, and general education. Eighteen different statements were then chosen, and each was paired once with the remaining 17, thus adding up to the 153 pairs found in the form. The form was checked simply by indicating a choice of one of the statements contained in each pair. A score is determined by counting the number of times each of the 18 statements has been chosen by one individual. A ranking of these scores will then show the order of preference shown for each of the statements.

A further check on goals held by homemakers was provided for on the last page of the inventory. Each person checking the form was asked to disregard the statements in the inventory and to state her own most important goals for homemaking. Two questions on the last page are concerned with the combined goals of husbands and wives, as well as with those that are not held in common by both.

This inventory of homemakers' goals was also pretested by the same group that had checked the questionnaire before it was set up in final form. The last two questions mentioned above, in addition to the rewording of certain of the statements, were added as a result of this pretesting.

The data provided through the inventory of goals completed all that had been originally requested from the homemakers in the study. However, it seemed desirable to have some check on the consistency of the replies from both the questionnaire and inventory. For this reason, ten of the group were interviewed.

The interview. It was thought necessary to develop an

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interview schedule that would approach the problem differently from the other instruments used in the study. Five questions, whose answers might reveal problems, satisfactions, and goals, were chosen. The first asked what, in the homemakers' opinion, should be the emphasis in the home economics curriculum; the second sought their idea of an excellent or ideal homemaker; the third asked what advice concerning homemaking they would pass on to young women about to be married; the fourth tried to locate what recent problems, if any, they had had since the time of filling out the questionnaire; and the fifth requested their opinion regarding the contribution which the home economist has to make to the welfare of the community. A sixth question sought their reaction to the study. The answers given served to bring out comments that led to discussions of other related topics which also revealed problems, satisfactions, and goals. The interviews of the homemakers concluded the final step taken in the collection of data for the study.

Outcomes of the Study

From the data provided by the 83 homemakers in this study it is possible to draw certain conclusions regarding their problems, their satisfactions, and their goals. Further conclusions may also be drawn in relation to their opinions concerning the help or lack of help received from their college home economics curriculum for the job of homemaking.

Problems of the homemaker. The problems designated most frequently were in areas dealing with management of income and management of household work. Problems related to balancing time between family and outside activities and to having adequate housing were also mentioned by over a third of the group. The problems designated least often were in areas dealing with family agreement on the essentials of a good home, caring for children's physical needs, and having adequate community resources.

Almost two-thirds of the employed homemakers indicated that they had problems in the areas of managing income and household work and balancing time between family and outside activities, but less than one-half of the non-employed homemakers checked these same areas as involving problems. Problems of managing household work and keeping a balance between family and outside activities were more frequent among the group married only one year or less than among those married a longer period of time. The homemakers with children tended to place emphasis on the problems of child care.

Analyzed descriptions which homemakers gave of their problems revealed that relationships and management were the basic problems, no matter what area of homemaking was involved. Fifty-five per cent of the basic problems found in these descriptions involved management and 42 per cent relationships. Management problems were further classified into those dealing with time, money, and energy. Relationship problems were further classified into those of husband-wife, parent-child, community, and kinship family.

Employed homemakers had a greater proportion of time management problems than did the non-employed homemakers. The group married one year or less had a greater proportion of time management problems and husband-wife relationship problems than did the groups married a longer period of time. The homemakers who had small children expressed problems dealing with parent-child relationships about as often as she did the management problems and husband-wife relationships.

Satisfactions of homemakers. Greatest satisfactions were found through twelve different sources: husband-wife relationships; ability to manage their time and energy; making home improvements; having children; the development of their children; ability to manage their income; the establishment of their own home; the occupational success of their husbands; the relationships they had in the community; performing some of the creative aspects of homemaking; and outside employment. A total of seventeen satisfactions in all were listed. The list above is in rank order, the one mentioned most often being first. In 51 cases satisfactions were seen as solutions or partial solutions to problems. The expressions of homemakers concerning satisfactions indicated that, in the majority of cases, they outweighed problems.

Goals of the young homemaker. Of the goals listed in the inventory the group, ranked highest were those dealing with relationships. Emotional security was ranked first, and was followed first by compatibility of husband and wife, and then by cooperation among family members. Physical health and religion were next in order. The goals ranked as least important were those dealing with acquisition of possessions, appreciation as a homemaker, and pursuit of personal interests. The ranking of the goals by individual members of the group, however, showed much variation from that of the total group.

The homemakers' own expressions of goals varies slightly from that of the inventory. Emotional security was, again, listed most often. However, physical health, cooperation among family members, and physical comfort were next. An additional goal not found in the inventory, efficient management of time, was also listed.

The combined goals of the husbands and wives indicated a slightly higher concern for adequate income and intellectual development than did those expressed by the wife. Disagreements in the goals of husbands and wives were mentioned by 32 of the group.

Relation of satisfaction and goals. In 48 per cent of the cases a relationship was seen between satisfactions and goals. The satisfactions found in husband-wife relationships compared closely with the high ranking of compatibility in the inventory; the goals dealing with having children and child development tallied with satisfactions of the same type. Other comparisons were in relation to management of money, community relations, and home improvements.

Relationships of basic problems and goals. In individual cases where it was possible to consider details of descriptions a definite relation between problems and goals was evident. In 60 per cent of the cases in the study a high relationship was seen between problems as described and the goals checked in the inventory. In other cases some relationship was seen and in a few cases very little or no relationship between problems and goals was evident.

Basic problem groups, however, showed no statistical difference in their ranking of goals. Hence there was no apparent relationship between different problem groups. This probably should not be unexpected, since the problems and goals for individual homemakers appeared largely in the form of clusters. In other words, the majority of the group had more than one basic problem, and even though

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one goal was ranked as most important, other goals which were given high scores were considered important to homemakers.

Homemaker's evaluation of the home economics curriculum. It should be noted that only a small group reported in each of the areas the help or lacks of help received. Home economics training was said to be of help in the job of homemaking in a number of ways. It has given some a point of view, or philosophy, regarding homemaking; others felt they had recieved a balanced knowledge of all phases of homemaking; and another group had been made aware of existing problems and means of solutions. They also spoke of the special help they had received through certain specific areas of the curriculum -- foods, home management, household furnishings, household equipment, clothing, household buying and budgeting, child development and family relationships.

Sixty-two of the homemakers gave suggestions as to how their home economics training could have been of more help. Their suggestions varied. A few wanted courses to be made more practical or to be based on everyday problems of the home; others wanted more in electives in the curriculum. Specific suggestions for different areas of the curriculum were also given by a small number of the group. The home management area was mentioned most often and the family relationships area least often. Other areas about which suggestions were given were child development, home furnishings, clothing, household buying and budgeting, and foods.

It was also discovered that some relationship existed between the values which some individuals saw in their home economics training and the satisfactions they had listed. A similar relationship was seen between problems of some homemakers and what they reported as lacks of help in the curriculum.

Implications for the Study

Methods of studying adequacy of the curriculum.

1. Faculties may well explore further the possibilities of the study of homemakers goals, problems, and satisfactions as a basis for an objective look at their curriculum.

2. The study of goals, problems, and satisfactions of homemakers in various stages of the family cycle should provide the curriculum with a source of useful material concerning family living.

3. The study of goals, problems, and satisfactions within the various home economics professions other than homemaking is also suggested as a means of evaluating the various professional curricula.

Emphasis in the core.

1. Goals, problems and satisfactions of homes and families may serve as the integrating elements of a homemaking core.

2. Certain types of problems, satisfactions, and goals would be common concerns of each of the areas of the core.

3. Special attention to management and relationships for both problems and satisfactions is seen as important for the core.

4. An emphasis on the interrelations of problems, goals, and satisfactions is suggested as a further emphasis for the core. Both problem solving and goal seeking are affected by this interrelationship.

5. The influence of qualifying factors such as children in the family, length of marriage, and employment of the homemaker on goals, problems, and satisfactions of families may also suggest a point of emphasis for a core staff.

Methods in teaching

1. A pool of narrative accounts such as were found in the study is suggested as resource material for home economics faculties. The use of such material may suggest attention to methods of using case data in teaching and in evaluating results.

2. An investigation by the staff into the various means by which both individual and family goals may be brought into the teaching of each of the core areas.

272 pages. $3.50. Mic 58-4829

Abstract published by special arrangement with The Ohio State University.

LANGUAGE AND LITERATURE

LANGUAGE AND LITERATURE, GENERAL

THE SINGLE COMBAT IN MEDIEVAL HEROIC NARRATIVE

(L. C. Card No. Mic 58-1388)

Taylor Culbert, Ph.D.
University of Michigan, 1957

In this dissertation, a study is made of the single combat in medieval heroic narrative, with emphasis on the English evidence. Too complex to be treated as a unit, single combat is divided into its component parts and each is discussed in a separate chapter: (1) motives leading to fighting, (2) boasts and challenges, (3) conditions and circumstances of the encounter, and (4) the physical struggle. In the last chapter, the dramatic and structural functions of single combat are examined. Though chiefly concerned with the nature and functions of single combat, the dissertation also yields insights into individual narratives and into the development of heroic story as a genre.

Some stories on which this study is based are products

of the Heroic Age (for example, Beowulf and representative Icelandic sagas); others, from post-Heroic ages, are similar, exhibiting both the heroic temper and a continuing preoccupation with personal combat: the native English legends (tales about Horn, Havelok, Fulk, Herward, Richard, Guy, and Beves), the Arthur and Alexander materials (Lawamon's Brut, Morte Arthure, Kyng Alisaunder, and The Wars of Alexander), the English feudal stories (six tales about Charlemagne and his warriors), and the Scottish heroic documents (poems concerning Bruce and Wallace).

Although a literary tradition founded on the early heroic stories exerted continuous pressure toward preserving single combat unchanged, the dissertation demonstrates that various social forces and literary fashions modified the form and functions of single combat during its development from Beowulf to The Wallace. In tales from the Heroic Age, the common motives leading to combat--vengeance, for example--were private, shared by no more than one or two men; moreover, they contained unmistakable identification of the particular foe whom the warrior experiencing those motives should oppose. Principally because motives alone sufficed to bring adversaries together for the purpose of settling their quarrels, boasts and challenges, circumstances of the fight, and even the physical contention itself could all be devoted to the revelation of human behavior and human nature--the central interests of the narrators. Because the conventional conflict depicted in these stories derived from the personal antagonisms of the leading men, single combat could resolve it. Furthermore, such conflicts formed the core or framework of many heroic tales; frequently, therefore, single combat resolved the main narrative conflict and satisfactorily concluded the whole story.

In tales from subsequent ages, however, single combat was gradually transformed. Religion and patriotism were introduced as grounds for fighting, but, unlike the personal motives they replaced, contained no clue identifying the one man among the many supporters of another religion or nation whom the hero should battle. Selection of the antagonist devolved upon boasts and challenges, and they, consequently, became very prominent. The narrators of these stories evinced little concern for the hero as a human being, but great concern for the ideals he stood for. As interest in the hero's behavior lessened, his combats were put to new uses: they illustrated pious or patriotic conduct or they served as colorless exploits to which wonders and extravagant adventures could be appended. Authors called upon religious or national controversies to provide the main narrative conflict in these tales, yet the narrowly personal quality of single combat prevented it from resolving such broad, public disputes. Fighting between two warriors might achieve a symbolic resolution of the fundamental narrative conflict, not a decisive settlement. Indeed, the opposing forces never were reconciled adequately; they clashed as violently at the end of the story as at the beginning. In short, single combat retained its former statistical frequency--each hero engaged in many hand-to-hand encounters--but its nature was altered and its narrative functions were changed. 325 pages. $4.20.

THE LANGUAGE OF MYSTICISM IN SOUTH GERMAN DOMINICAN CONVENT CHRONICLES OF THE FOURTEENTH CENTURY

(L. C. Card No. Mic 58-1404)

Hester McNeal Reed Gehring, Ph.D.
University of Michigan, 1957

Amid the extensive investigations undertaken during the past half century into the language of medieval German mysticism, one form of mystic writing has received scant attention: the chronicles compiled from about 1318 to 1360 in South German Dominican convents. Commentators consider that the language of these chronicles is pedestrian and derivative and the phenomena which the language depicts lack authenticity. While this criticism has a certain validity, such an evaluation of the chronicles does them less than justice. To determine what contribution was made by the chronicles to the language of medieval German mysticism has been the purpose of this study.

Six chronicles were selected for investigation (from the convents of Adelhausen, Engeltal, Oetenbach, St. Katharinental, Toss, and Weiler). The procedure followed was to analyze the language used in each chronicle and to correlate the findings into a composite picture of the terminology employed by the chroniclers as a group to express certain basic mystic concepts and other aspects of mystic life. For ease of presentation related concepts were grouped together into four distinct yet closely interlocking sections. One part discusses the language of active life, another that of visionary life -- visions, revelations, and supernatural manifestation to the senses of smell and taste; a third deals with the core of mystic belief, unio mystica and its associated raptures or ecstasies. Use of this method of organization has made it possible not only to emphasize individual variations in language from one chronicle to another but also to delimit those areas of expression which the six texts have in common.

In all such discussions the point of departure has been the terminology involved, with stress laid on the semantic rather than the linguistic aspects. However, mystic language cannot be understood without some knowledge of mystic life and thought, hence this study has considered the background of the chronicles, literary, social, and religious, and has also attempted to interpret the mystic concepts which the terminology is used to depict.

Detailed research reveals the fact that the language of the chronicles is better and more significant than it has been said to be and that the chronicles themselves do make a definite contribution to mystic language of the waning Middle Ages. They present in complete detail the terminology of practical mysticism: all the facets of mystic living and dying are mirrored in the chronicle language. Accounts of visionary phenomena may be unoriginal in content. The language used to describe them reflects the impact on the individual both of such supernatural occurrences and of the peculiar physical and psychic tensions generated by the group.

The convent chronicles, therefore, must be accorded a small but far from negligible position in the pattern of mystic language as it remains to us from documents of the late Middle Ages. It is the writer's hope that this study may rescue from unmerited disregard the chronicle language and help to shed further light on the life and spirit of the unique women whose spiritual biographies comprise the chronicle literature. 378 pages. $4.85.

THE FRENCH REVOLUTION IN THE BRITISH DRAMA: A STUDY IN BRITISH POPULAR LITERATURE OF THE DECADE OF REVOLUTION

(L. C. Card No. Mic 58-1289)

Theodore Godfrey Grieder, Jr., Ph.D.
Stanford University, 1958

The purpose of this work is to examine the reflections in the British drama of various ideas directly or indirectly related to the French Revolution in the years 1789-99. Because the quality of this drama is inferior, I place chief emphasis upon the currents of thought reflected in the drama rather than upon artistic trends in dramatic genres, although I discuss the literary qualities of a number of selected plays in Chapter I to enable the reader to picture the kind of dramatic work being done in these years. The attitudes of the significant philosophers and poets of the Revolutionary Decade have been examined thoroughly in previous studies as have been the novels of these years, but the plays concerning the Revolution have not been studied systematically. A treatment of the plays should contribute to an understanding of the thoughts and feelings of the British during these times.

The chronological limitations of this work are set by the events of the Revolution itself: the fall of the Bastille, July, 1789, and Napoleon's rise to First Consul in October, 1799, at which time the Republic gave way to the dictatorship of a military leader. Within this decade, I establish three subdivisions: from the fall of the Bastille to the outbreak of war between France and England, February, 1793; from the outbreak of war to the British evacuation of Bremen, April, 1795; from this evacuation to Napoleon's rise to power. I call the first subdivision "the early years," the second, "the middle," and the third, "the later."

I treat the major ideas around which I have chosen to organize my discussion through the full ten year span within individual chapters; but within each chapter, I discuss the major subject more or less within the chronological subdivisions earlier designated. It is obvious that such a plan serves merely for convenience of discussion; we should remember that a play written in the middle years may very well deal with events occurring in the earlier.

In the first chapter, I consider in some detail individual plays directly or indirectly owing their existence to the Revolution or to the resulting military conflict between France and Britain. The major subjects of the last five chapters have to do with British views of rationalism and benevolence; of rank, liberty, and equality; of social change (related to parliamentary reform), the slave trade, and the status of women; of national groups; and of English nationalism.

In my introduction and in the body of the work itself, I also discuss the effect of various forms of censorship in repressing dramatic references to the Revolution. In the Appendix, I consider in some detail the phenomenon of the rage for the German drama, at its height in 1798-9. Preceding the Bibliography is a Checklist of the some five hundred plays which I have examined in this study. The Checklist reveals whether or not a play was acted and indicates the popularity of the acted plays.

This study demonstrates that dramatic expression became more conservative as the events of the Revolution became more violent, and also indicates that the Revolution and the ideas related to it greatly influenced dramatic attitudes and, often, were directly responsible for the creation of particular plays. 383 pages. $4.90.

PASCAL AND THE CRITICS OF THE PENSÉES

(L. C. Card No. Mic 58-1347)

Leo Donald Maher, Ph.D.
Columbia University, 1957

This study presupposes the importance of cultural history. Pascal's Pensées have been especially stimulating to criticism since their first publication in 1670. Critical responses to the Pensées are seen to be valuable since they shed light on the Pensées themselves, since they reveal the cultural and personal bias of the given critic, and, finally, since they offer commentary on that critic's own work.

Eighteenth-century reactions to the Pensées (those of Voltaire, Condorcet, Pope, Arbuthnot) reveal either the rationalist bias against Pascal's fundamental assumptions which one would expect or they show an effort to assimilate the Pensées to a genteel and optimistic Christianity out of keeping with the rigors of Pascal's Augustinian and Jansenist thought.

Nineteenth-century criticism treats the Pensées more sympathetically but it tends at the same time to over-emphasize their pessimism or to continue the bien-pensant depreciation of them. Over-emphasis of their pessimism characterizes the critical reactions of Sainte-Beuve, James F. Stephen, and Matthew Arnold while, from Chateaubriand to the end of the century, the bien-pensant tradition continues to exercise its influence. Moreover the rationalist attitude towards the Pensées, as exemplified by Leslie Stephen, retains much of its force. As it is represented by Walter Pater or André Suarès, late nineteenth-century criticism combines all these attitudes and adds its own characteristic aestheticism.

In the twentieth century, earlier responses to the Pensées survive and are complicated by a political use of the work and by an effort to adapt Pascal's insights to the insights of contemporary religious needs. Paul Valéry is an outstanding representative of a continuation of the rationalist undervaluation of the Pensées; T. E. Hulme and Maurice Barrès of the effort to make political use of them; and T. S. Eliot of the attempt to preserve some, if not all, of their religious significance. There has also been an effort, albeit a minor one, to affiliate Pascal with the cause of what is loosely called existentialism.

An awareness of the changing attitudes towards the Pensées not only serves as a key to the understanding of much of the intellectual history of the last three centuries; it also helps the reader to an understanding of the continuing vitality of Pascal's thought. Finally, a study like the present one makes it clear that Pascal's Pensées, his central work, should be taken as a whole rather than utilized piece-meal in the service of partisan ideals. Otherwise an artificial reading of the Pensées which obscures their essential meaning results. 247 pages. $3.20.

LANGUAGE AND LITERATURE, CLASSICAL

METRON, MESOS, AND KAIROS: A SEMASIOLOGICAL STUDY

(L. C. Card No. Mic 58-970)

Robert Theodore Otten, Ph.D.
University of Michigan, 1957

The purpose of this study is to trace the words metron, mesos, and kairos in their historical development from Homer through the writers of the fifth century and partially into the fourth century. These terms were chosen because, while their basic meanings appear to be so different, yet they frequently cross and overlap each other, particularly in the concept of moderation or measure.

The study is divided into two parts: the first deals with the literary tradition, the poets, dramatists, and prose writers through Xenophon; the second with the scientific-philosophical tradition, the Pre-Socratics and the authors of the treatises included in the Corpus Hippocraticum.

In Part I it is discovered that the ethical connotation of metron is primarily a development of metron as "limit" in Homer. Metron in this sense is most often the object of a verb of knowing, and this points to metron as that aspect of a thing which is knowable in a concrete sense; knowledge of metron is knowledge which can be put to practical use or which issues in some moral action. Metron as "limit" leads to metron as "criterion," or "standard of judgment." Mesos appears in an ethical sense in Theognis, who gives it a political orientation, and in whom it frequently joins metron as the contrary of excess. The character of kairos is first fully delineated in Pindar, who presents it under two aspects: objectively it is occasion with its demands upon the person whom it confronts; subjectively, kairos is the perception of this occasion with an adequate response to it. These two aspects are both involved in all the occurrences of kairos in Pindar, though one of the two aspects predominates in any given instance. Such meanings of kairos as "due measure," "critical time," or "opportune time" are developments of this objective aspect (occasion). The temporal element of kairos in Pindar is clearly subordinate.

The Dramatists and Prose Writers do not significantly enlarge the area of meaning in any of the three terms. The original force of kairos is somewhat diminished, and its temporal element becomes increasingly dominant. The close semantic relationship of metron and kairos is illustrated in the comparative genitive construction, where tou metriou and tou kairou become almost synonymous; it is in the areas of speech and ethics that metron and kairos most frequently meet. Metrios and mesos are both opposed to the upper extreme of excess.

In Part II symmetria assumes greater significance. In the Pre-Socratics symmetria and its forms are used especially to denote a state of equilibrium between various and opposing forces, a state which is constantly threatened by the excess or deficiency of any one of these forces; this symmetria becomes a "mean" situated between opposing extremes. To metrion and kairos are closely allied in the ethical thought of Democritus. Kairos is used by the Pythagoreans to denote the social virtue of "propriety"; Protagoras and Gorgias apply it to the art of rhetoric. Mesos and mesotês appear as technical terms in mathematics and music. To meson in Polycleitus approaches kairos as artistic sensitivity, a development of the subjective aspect of kairos; symmetria appears as the basic principle of the representational arts.

The treatises of the Corpus Hippocraticum employ to metrion, kairos, and symmetria interchangeably as "mean" and "due measure." Kairos in its subjective sense enters the field of medicine as the perception required of a physician, a perception demanded by the individual nature of each case treated. Kairos is, however, not something irrational; it is part of the medical art; it is medical epistêmê in its highest form. Mesos and its forms play a minor role. 178 pages. $2.35.

LUCRETIUS' IMAGERY, A POETIC READING OF THE DE RERUM NATURA

(L. C. Card No. Mic 58-1096)

George John Sullwold, Jr., Ph.D.
University of Washington, 1957

Philosophical and philological interests have been the prime motive in most extensive treatments of the De Rerum Natura. The poem is admittedly a valuable source of philosophic doctrine, but it is primarily a poem and not by intention a discursive statement of a philosophic system. Although some recent studies have dealt with the imagery and texture of certain parts of the poem, there has been a tendency among scholars and editors to exaggerate the clash between poetry and philosophy. This study is an attempt to view the whole poem as an autonomous verbal structure and to examine the major types of imagery as embodiments of the philosophic theme and as sources of the feelings engendered by the poem.

Why an Epicurean should write a poem is not a really serious problem. The physical philosophers were not as divorced from the poet seers as they believed. The basis of Epicureanism, the theory of atoms and void, was arrived at by intuition rather than by empirical procedure. Materialism thus founded is not antithetical to the poetic mode. Likewise by the first century B.C. the Epicureans had become interested in literature and literary theory. Lucretius as a poet was attracted to Epicureanism.

Lucretius' method is essentially poetic. Dogmatic statements supported by imagery carry the argument. He exploits the metaphorical value of words, especially verbs, and thereby injects life and vitality into the verse. The dominant metaphors of flow and pour stress the idea of change and contribute to the feeling of motion. There is a marked tendency away from abstraction to concreteness.

In spite of his sympathy with the Epicurean religious doctrines, Lucretius makes use of imagery drawn from ritual and traditional religious attitudes without, however, weakening the doctrine. The force of tradition also appears in the use of mythological metaphors and in personification. Mythology and personification render the doctrine concrete and viable for the poetic mode. The earth-mother image is central to the poem and supplies a functional analogy to the atomic doctrine. Myths are allegorized and rationalized so as to mitigate the discrepancy with the doctrine. Personification brings the workings of nature into terms of human experience.

The theme of mortality is projected in the poetry. The

poem itself is constructed between the poles of life and death. The imagery of light ranges in expression from literal birth to artistic creation. Conversely, darkness is death, ignorance and chaos. Liquid imagery is ambivalent. Water is a creative force; birth and increase are a pouring forth. Death and diminution are a flowing and death is dark waters. The concept of cosmic mortality makes use of most all the imagery of change and flux and gives gigantic momentum to the poem.

Doctrinaire statements about peace and equanimity are not supported by any large groups of imagery. Disorder ultimately characterizes most of the universe, the laws of nature notwithstanding. The imagery of warfare, disease, and tempest is extensive and striking. Although the theme of mortality dominates, an insistent affirmation of life is made in the imagery of flowering which implies maturity, joy, perfection, and fertility. This imagery, in addition to the doctrine of free will and the doctrinaire claims for equanimity, create a dramatic tension with the imagery-supported themes of death and disorder.

195 pages. $2.55.

LANGUAGE AND LITERATURE, LINGUISTICS

THE NATIVE AMERICAN ENGLISH SPOKEN IN THE PUGET SOUND AREA

(L. C. Card No. Mic 58-1073)

Frederick H. Brengelman, Ph.D.
University of Washington, 1957

The Puget Sound area is closely unified by geography, economy, and culture. It has, at the same time, a heterogeneous population which has been dominated at different times by migrants from New England, the inland northern United States, and the central states. Important proportions of the population of the area have also come from the British Empire and northern Europe. A study of the language of the area should thus be expected to provide valuable evidence for conclusions about the effects of migration and mixture on a developing common language.

The present study has attempted to carry out the following objectives:

(1) To describe the actual pronunciation of English in the Sound area.

(2) To determine its relationship to other regional dialects, particularly those of the eastern United States.

(3) To describe differences between the dialects of the aged and young, the rural and urban, and the educated and uneducated and to compare these differences with those reported from various sections of the eastern United States.

(4) To discover by means of these comparisons what factors have been most important in establishing the dialect features of the Puget Sound area.

The data used for the study were the phonetic transcriptions of interviews of thirty life-long residents of Puget Sound towns and rural areas. The interviews were made as part of the research for the Linguistic Atlas of the Pacific Northwest. Each record contains about 600 items (words and sentences), many of which have lexical and morphological as well as phonological significance. Separate tabulations were made of the three kinds of data in each record. These formed the basis for a phonemic analysis and a number of comparisons between the dialects of the local social classes and between those of this area and the East. The morphological and lexical data were compared with those relating to phonology to determine whether they would support the conclusions reached with respect to regional and cultural dialect relationships.

The evidence collected for this study suggests the following general conclusions about the development of a common language in this region:

(1) Vocabulary and pronunciation have been established here by the predominant settlement groups, namely, those from the northern and north midland areas of the United States, rather than by the groups who made the first settlements in the area, the Canadians and New Englanders. As a result of heavier Northern settlement west of the Sound, the speech of that area is more consistently Northern than that of the east side.

(2) Regional forms have often been replaced by national ones, specifically in those instances where a great deal of speech variation existed among settlers of the area. This applies to vocabulary, grammar, and the pronunciations of particular words, but not to the phonemic system.

(3) The shifting economic and social status of newcomers to the area has apparently resulted in a blurring of linguistic class boundaries. Here there are fewer differences between the dialects of the cultured and uncultured, the rich and poor, and the rural and urban than in areas having a more stable population. The speech of the aged is, however, distinguished from that of the young by differences in the phonemic system, in pronunciation, and in vocabulary.

225 pages. $2.95

LA GRAN CONQUISTA DE ULTRAMAR, BOOK IV, CHAPTERS 126-193, CRITICAL EDITION, GRAMMATICAL ANALYSIS, AND GLOSSARY

(L. C. Card No. Mic 58-1414)

Vladimír Jiří Jaroslav Honsa, Ph.D.
University of Michigan, 1957

La gran conquista de Ultramar is a Spanish history of the Crusades between the years 1095 and 1271. The original history of the Crusades was written by archbishop William of Tyre between 1170 and 1183 and was entitled Historia rerum in partibus transmarinis gestarum. This Latin work was translated into French and circulated under the title L'estoire de Eracles empereur et la conqueste de la Terre d'Outremer. Additions were made to this translation and the history continued in Old French until the year 1277. The Spanish version, La gran conquista de Ultramar, was translated from the French translation and its continuation, probably during the reign of Sancho IV (1284-1295), and has been preserved in three incomplete manuscripts and in one complete printed edition. The

chapters of the Spanish history presented in this dissertation are a translation of the French continuation and do not, therefore, have a Latin source. These chapters treat a unified and important series of events, the capture of the kingdom of Jerusalem by Saladin, and cover a period of three years (1186-1189) of the reign of Guy of Lusignan.

The critical text prepared in this dissertation is based on the two manuscripts that contain the chapters chosen and on the complete printed version. These three sources of the Spanish text are: MS J-1 of the Biblioteca Nacional, Madrid (from the beginning of the XIVth century); MS s.n. of of the Biblioteca de Palacio, Madrid (from the beginning of the XVth century); and the edition printed in Salamanca in 1503, now in the British Museum, London. MS J-1, being the oldest and the most authoritative version, has been used as the basic text. The variants of the other versions are recorded in footnotes. Two critical editions of Old French texts have been used for the purpose of comparison and validation of the Spanish taxts: one of the Académie des Inscriptions et Belles Lettres, the other of the Societe de l'Histoire de France.

The grammatical analysis, which follows the edited text, is divided into three main parts. The first, §§1-13, is a descriptive study of the language of the text; §1 deals with the phonemic system, the distribution of the phonemes, and their orthographic representation. The second part, §14, presents historical linguistic phenomena indicative of the assumed date of the lost original Spanish version of La gran conquista de Ultramar, the end of the XIIIth century. The third part, §15, analyzes the influence of Spanish dialects and foreign languages on the language of La gran conquista de Ultramar. Quotations illustrate categories of the grammatical analysis.

The glossary which follows the grammatical analysis explains and illustrates words now rare and antiquated and those words of modern usage which have changed radically from their Old Spanish meaning or phonological aspect. The glossary is etymological and lists numerous citations from other Old Spanish texts. Since the Spanish version is a translation, corresponding Old French words from the original are included in the glossary.

La gran conquista de Ultramar is one of the important early Spanish literary works that still lack a critical edition. No study of its language or vocabulary exists. This dissertation represents one part of what, it is hoped, will eventually be a complete critical edition of this extensive literary work. 291 pages. $3.75.

THE SEMANTICS OF POLITICAL CARTOON AND SLOGAN IN AMERICA, 1876-1884

(Publication No. 25,425)

Travis Edward Trittschuh, Ph.D.
The Ohio State University, 1952

A thorough study of the political cartoons in Harper's Weekly from January, 1876, to December, 1884, reveals that a few symbols occur with a frequency that implies that they occupied significant places in the political vocabulary. By compiling the complex histories of eleven of these terms--boodle, boom, Columbia, deadhead, dude, magnetism, plumed knight, rag baby, soap, tattooed man, and Uncle Sam--relationships have been discovered which not only illuminate the historical event but also reveal the factors in semantic transfer.

The most obvious fact shown in all the histories is that no expression is created or exists in a vacuum. There is a setting which makes its inception possible and a state of collective preparedness which assures its reception and propagation. An important phase of the study has been, therefore, the evolving of a methodology for treating the slogans and cartoons in their proper milieu. The dangers and weaknesses of the "guilt by association" type of reasoning were encountered in the case of boom, in which a logical metaphor and the fact that its quotations are found in an appropriate source made an origin seem obvious. The problems arising from isolated usages were encountered in boodle and dude. So it became evident in these cases and throughout that the only way to be certain of an etymology is by the inclusion of a full history of the background in which the use of a particular term becomes possible. This involves a careful investigation, usually beginning with the earliest known quotation, of the political situation which prompted the use of the expression. If the metaphor is obvious, the search is next directed to the area of activity which it indicates. Thus tattooed man implied a use of a circus or sideshow metaphor, and plumed knight indicated a transfer from literary or historical spheres. If the metaphor is obscure or ambiguous, as we have seen to be true with Boom and dude, then it is necessary to consider all possible metaphors, which are suggested either by known quotations or by internal evidence from later uses of the symbol in editorials or cartoons. The emphasis must be on the discovery of all details, whether they be historical, social, psychological, or scientific, which are essential to the formation of a possible pattern for the creation of the symbol. "Missing links" can then be the object of special research until the pattern is a complete and integrated one, and, as has been shown in several instances, the case may not be solved by the efforts of any one linguistic detective. His facts may be only the clues to other and more conclusive discoveries.

Even within the narrow limits of this selective study it is apparent that the sources of political metaphors are in various fields and are based upon relationships which at first seem almost too tenuous to merit serious consideration. Among the countless sources a few of the more important, at least from the viewpoint of their offering more prolific possibilities for metaphorical transfer, are literature, mythology, nature, war (military and naval), the domestic scene, and current events (including words and actions). The creator of the metaphor may be guided by a similarity in the political and source setting which would be obvious to everyone: thus Thaddeus Stevens could explain the House's surprising submission to the personality of James G. Blaine by identifying his force with the mysterious animal magnetism. Or there could be factors in the creator's personal experience or knowledge which made the metaphor an obvious one for him, as for example, McCullagh's supposed motivation for boom or Gillam's use of tattooed man. And again the final metaphor could be applicable only after intermediate metaphorical stages have connected it with the original expression, such as in the development of soap. Regardless of the closeness of the relationship between the metaphor and its origin, there is always a patterned chain of circumstances by which if all the links are known, the logic of the metaphor becomes

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apparent. This chain includes not only documented quotations, but also the appraisal of the physical similarities of the two referents and the conditioned setting in both time and place.

We may find that instead of a single metaphor, we are dealing with many. Boom is a case in point. The marginal connotations from the nautical and flood metaphors coalesce, so that there is a strengthening of those connotations implying rapid movement, while at the same time the other metaphors, such as the cannon and the business ones, add values which give the term adaptability. The multiplicity of images already in existence, of course, increases the term's possibilities for immediate acceptance. Secondary metaphors serve to bolster the power of a weak political symbol or to renew its vigor. Plumed knight would have offered limited uses to Thomas Nast if there had not also been the white feather, and we may speculate how and in what guise Uncle Sam would have survived had Brother Jonathan and Jack Downing not been subsidiary symbols. Instead of coalescing, metaphors may occasionally contaminate one another, the resultant being unlike either one, as in the "deadbeat" cartoon of Blaine, in which the appearance of the beet is fused with the connotations for the deadhead. Such corrollary developments of metaphors are indicative of the way in which associational values, whether they be suggested by puns, shuffling of symbols, or mechanization, tend to create fresh metaphors.

With only one exception the normal development of the metaphor was from the concept to word to cartoon. Only with dude did the cartoon appear first, and even in this instance the political cartoon followed the political term. This is not surprising when we consider the function of the cartoon. It is created to point out - either to praise or to damn - a particular phase of the political scene in order to evoke a specific reaction. To do this, it must deal with that which is basically familiar, so that there will be an immediate recognition of the intention of the cartoon. In the normal development of the symbol, although the word precedes the cartoon, the relationship between the two is not one of primary and secondary symbols. The two symbols share connotations and continue to reinforce one another by their continued use. If as in the case of tattooed man or rag baby the artistic symbol becomes the dominant one, it serves to support the life of the less spectacular verbal expression by acting as a kind of secondary or supporting metaphor itself. If the metaphor seems to be suitable to only one medium of expression, as for example, boodle, then the few instances in which the artist desires to create a cartoon with symbols which will suggest the concept, he must depend upon verbal identification to make the symbol complete and comprehensible. A label tends to destroy the effectiveness of a symbol since it requires a fixation of sight which can destroy the unity of response to the unit image.

A good symbol, as has been clearly demonstrated in the rag baby cartoons, is, first of all, a simple one. It should be completely comprehensible at one glance, and yet should carry connotations that will make it an object of perusal and of extending implications. Uncle Sam and Columbia in their development lost those unnecessary embellishments which were not essential to their identification. The kind of boots that Uncle Sam wore was of little concern so long as he had a top hat, swallow-tail coat, and striped trousers, and Columbia early exercised the perogatives of a goddess and refused to bow to the changing demands of fashion but reigned supreme in flowing gown and diadem. Even the tattooed man, despite all his ornate scrolls and lettering, was an effective symbol because it was possible to evoke the desired response by a glance at his grotesqueness without reading the indistinct tattooes.

A good symbol must be adaptable. A negative example is the one visual interpretation of deadhead which always had to depend upon the Blaine quotation for clarification. The Communist deadhead, on the other hand, was a flexible symbol because it could be expressed by a skull or skeleton, which thus incorporated connotations of death arising from the pictorial symbol and of the sponger or political parasite from the verbal metaphor. This deadhead symbol was thus identifiable in any motif in which the context implied a criticism of or antagonism toward society. The flexibility of Uncle Sam was almost beyond belief when the pen of an imaginative and, perhaps, enraged cartoonist was at work, but Columbia, although without a doubt an excellent symbol, was, as we have seen, a limited one.

This fact brings to our consideration another factor which is a determinant of the motivation and development of a symbol and of its continued usage. That is the cultural gestalt which impinges upon the psychology of both the creator and the audience. In the examples of Uncle Sam and Columbia we have seen not only the need for a personification in which to center manifestations of patriotism, reverence, or government criticism but also the tabooes and restrictions which have narrowed the development of the symbols along specific channels. The American who used either of these symbols was thus conditioned by his own experience and training to react to the symbol according to the traditions of his culture. Rag baby, in addition to being a metaphor fusing the connotations of rag and baby, was also an appropriate symbol because fortunately the rag baby was the only type of infant that our culture would allow to be the object of all varieties of abuse and maltreatment. It could be used in contexts treating it as a live child, but it was always obvious that it was a stuffed and senseless rag doll. The tattooed man was called blasphemous by some, but it violated the taboos of the period no more than did Captain Costentenus in the Dime-Museum or any other cartoon showing the scandals and corruption associated with Blaine.

Any symbol then to be an effective political symbol must conform to the dictates of the culture in which it fills a need. If in filling that need, it becomes a part of the cultural heritage itself then it assumes the position of an unchanging and unassailable icon. If it fulfills a propaganda purpose or merely a communicative one, its use is still proscribed by cultural bounds, which the artist or the editorial writer will consciously and subconsciously observe in the appearance of the symbol and in the function given to it in the motif or in the contextual implications upon the metaphor.

Personal vagaries and prejudices will also be manifest; in cartoons primarily by methods of sketching such as shading, heavy lines, or distortions; in writing by style and literary type. In the 1884 campaign the symbols directed against Blaine indicate that their creators felt him to be a foe not worthy of attack on a serious level involving discussions of his opinions and program. Instead, Nast and Gillam ridiculed him by grotesque caricatures in asinine situations, and countless writers lampooned him in doggerel and puns.

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The effectiveness of a political symbol depends, however, upon more than the worth of the symbol as determined by an objective analysis of it in its context. The timing of its use is also an important factor in its reception. Tattooed man, magnetism, and plumed knight could all have been turned against Blaine in 1876 or 1880, but their function would have been ended when he failed to capture the nomination. Even in 1884, it was not until the June cartoon of "Phryne before the Chicago Tribunal" that tattooed man became an extremely powerful symbol. At that time the cartoon paralleled the meeting in Chicago, and the relationship became a valid one.

In two of the metaphors mentioned above we can also see the value of the ambiguous polarity of a symbol for propaganda purposes. Plumed knight and magnetism had come into the political vocabulary as expressions praising virtues of Blaine, but by confusing them with derogatory metaphors and distorting their intended connotations, it was possible to convert them into expressions of ridicule and satire. Boom could be a term denoting an honest statement of a political trend or it could be the symbol of a candidate's foolish effort to beat his own drum.

In addition to the relationship between verbal and pictorial symbols of the same concept, in which each reinforces the public receptivity of the other, there is also a complementary action between unlike symbols and expressions of the two different media. In politics, the use is confined chiefly to verbal supplements of cartoons. The humor or satire of a cartoon may be augmented by jingles, puns, or amusing speeches and signs. Such supplements not only add to the humorous effect but they exercise a conditioning influence upon the symbol and cartoon. They may intensify the atmosphere or tone of the cartoon and thus are an environmental factor in the total impression created by the symbol. They should not, however, occupy a position in the cartoon that will divide the initial attention of the reader.

The semantics of political symbols involve, therefore, not only a thorough study of the background of the individual symbol, including its environment, metaphorical changes, and other conditioning factors implicit in the history of the symbol itself, but also the relationship which other symbols, both verbal and visual, exercise upon it. There is a reciprocal action in the association of any two symbols, with connotations from each creating a third metaphor which exists in the impression exacted upon the reader or viewer. 204 pages. $2.65. Mic 58-4830

Abstract published by special arrangement with The Ohio State University.

THE LOW-CENTRAL AND LOW-BACK VOWELS OF THE EASTERN UNITED STATES

(L. C. Card No. Mic 58-1015)

Thomas Hall Wetmore, Ph.D.
University of Michigan, 1957

The purpose of this dissertation is to analyze and describe the low-central and low-back vowel phonemes, their phonic characteristics, and their incidence in the Eastern United States. The primary source materials for the study are the field records of the Linguistic Atlas of the United States and Canada, representing the speech of approximately fourteen hundred informants in some seven hundred communities in the Eastern United States. These field records, collected during the past twenty years under the auspices of the American Council of Learned Societies, are housed at the University of Michigan.

The following eight representative areas, selected on the basis of speech areas established by Professor Hans Kurath in A Word Geography of the Eastern United States, are investigated: in the North, coastal Maine and southeastern New Hampshire, western Vermont, and Metropolitan New York; in the Midland, southeastern Pennsylvania, western Pennsylvania, and western North Carolina; and in the South, eastern Virginia and eastern South Carolina.

For each area, two typical words are selected, one of the type of tot, expected to have the phoneme /a/ in most of the Eastern States, the other of the type of taught, expected to have /ɔ/ in most of the same area. The phones in these two words are compared to see whether in any given area they are distinct or overlapping. The absence of overlap indicates the existence of two separate phonemes, /a/ in tot, /ɔ/ in taught. The complete or nearly complete overlapping of phones indicates that both words of the type of tot and of the type of taught have one and the same phoneme, which is designated as /ɐ/, since a low-back slightly rounded phone is the most frequent one in such areas.

After deciding upon the existence, in any given area, of the phonemes /a/ and /ɔ/ or a single phoneme /ɐ/, we describe the positional allophones, the social diaphones, and the regional diaphones.

Finally, for areas having both /a/ and /ɔ/, a description is given of the incidence of the phonemes in the vocabulary, arranged by historical types. Marked regional and social dissemination of the phoneme is presented. Whenever possible, the dissemination of the phonemes is related to the settlement history of the area.

Throughout the study figures and tables are used to enable the reader to check the generalizations and interpretations.

The results of the study may be summed up as follows: Both /a/ and /ɔ/ occur in all of the areas except two: (1) western Pennsylvania and (2) coastal Maine and southeastern New Hampshire. In the two exceptional areas, both words of the type of tot and words of the type of taught have the phoneme /ɐ/.

In coastal Maine and southeastern New Hampshire the falling together of words like tot and taught is compensated for by the low-front phoneme /a/, which is found in words such as car, barn, path, glass, pasture. Western Pennsylvania, on the other hand, where the vowel of car is an allophone of /ɐ/, has one less phoneme between /æ/ and /o/ than do other dialects in the Eastern United States.
295 pages. $3.80.

A STUDY OF TEACHERS' ATTITUDES TOWARD DEBATABLE ITEMS OF ENGLISH USAGE

(L. C. Card No. Mic 58-1368)

William Thurston Womack, Ph.D.
Columbia University, 1957

The present study was undertaken to provide objective evidence that teachers' attitudes toward debatable items of English usage are affected by two kinds of experience: academic as revealed by background of course work and familiarity with important publications in language study, and environmental and social, including size of community in which the teacher teaches, years of teaching experience, and level at which the teacher teaches.

Teachers surveyed were members of the National Council of Teachers of English and included elementary, high school, and college teachers. A random sample of 900 was chosen. Three hundred and thirty-nine or 38 per cent of the questionnaires sent out were returned.

Previous studies have provided evidence that high school teachers in small towns held the most prescriptive views toward debatable usages. The present survey confirms this tendency and studies two other variables, extent of teaching experience and highest degree held, in relationship to teachers' attitudes toward usage. The results of the present study show that the teacher most likely to reject items of divided usage is the high school teacher with more than ten years of teaching experience, presently teaching in a small town, holding either an A. B. or an M. A. degree. On the other hand, the teacher most likely to accept items of debatable usage is the college teacher with less than ten years of teaching experience, presently teaching in a city of more than 50,000 persons, and holding a doctor's degree. The data which led to these conclusions suggests clearly that the tendency to accept items of debatable usage is directly related to linguistic sophistication.

The great majority of all teachers in the survey admit variation in usage between speech and writing, and within speech and writing for formal or informal uses. The teachers reveal a more restrictive standard for writing than for speech. A close scrutiny of each usage item included in the study reveals that generally the majority of the respondents still reject most usages that published information (usage studies and dictionaries) tends to support as acceptable. Two explanations, as revealed by teachers' written-in comments, seem likely. Either the majority of the teachers are not influenced by the published information at hand, or they feel that they as English teachers, despite usage studies to the contrary, must resist certain kinds of "undesirable" language change.

There is some evidence in the data of the survey, though it is not preponderant, that there are teachers at all teaching levels who hold present-day standards of correctness, a descriptive rather than a prescriptive view toward usage study and usage teaching. At the same time, however, there is ample evidence of the retention of puristic attitudes toward language study and teaching by many teachers of English.

The present study demonstrates a methodology for relating teachers' attitudes toward usage with a number of variables which might possibly influence teachers' attitudes toward usage. It is the recommendation of the present study that this technique be further explored and refined.

Few teachers included in the survey had taken courses in linguistic science or were familiar with the work of the important linguistic scientists. Since linguistic science today has established a well-defined methodology for language study and a sound and substantial body of reliable facts about the nature of language, it is the recommendation of this study that regardless of teaching level there be included in the preparation of teachers of English a sound orientation in the views and methodology of modern scientific language study. 198 pages. $2.60.

LANGUAGE AND LITERATURE, MODERN

JOYCE AND THE NEW PSYCHOLOGY

(L. C. Card No. Mic 58-1329)

Leonard Albert, Ph. D.
Columbia University, 1957

This study explores the relations between the prose works of James Joyce and the psychoanalytic schools and their immediate antecedents. It begins with a survey of the confluence in time of the Viennese school and the earlier works. Joyce's linguistic capacities, his interest in dream analysis, his abortive attempts to become a medical student first in Dublin, later in Paris, and his omnivorous reading in the Bibliothèque Nationale are juxtaposed with the acquisition in 1900 by the Bibliothèque of Freud's Die Traumdeutung to demonstrate the possibility that the Irish writer might have become acquainted with depth psychology as early as 1902. That possibility is not a likelihood. However, the long years spent in Trieste and Zurich from 1904 to 1919, the period of his greatest literary output, placed Joyce geographically and temporally in the centers of the analytic movement.

After exploring the critical and biographical opinions on both sides of the question, evidence from Joyce's notebooks and other unpublished data is examined for clues to his possible acquaintance with the psychoanalytic theories at various stages in his career. A note book dated 1914 contains a small collection of Joyce's dreams with analyses of each, written in Joyce's hand. The method of analysis seems similar to that set forth in The Interpretation of Dreams. Another notebook containing early notes and drafts used in the composition of Ulysses and dating from about 1914 refers to "Siegfriedmund Ueberallgemein," possibly a parody of the name of the founder of psychoanalysis. Additional "external evidence" is also explored and related to the reference in the manuscript of Ulysses to "the Viennese school" and to the published redaction of that phrase, "the new Viennese school," mentioned in the Library episode of the work.

The possibility that the work of Jung might have played a role in the earlier works is considered, and the evidence, including letters from the Swiss analyst to Joyce and to the author of this study, is evaluated.

While there appears to be no conclusive evidence outside the text of Ulysses that the Viennese precursor of psychoanalysis, Richard von Krafft-Ebing, affected the works of Joyce, textual examination reveals some internal

evidence that Psychopathia Sexualis was among the source-works, particularly in the composition of the Circe episode.

The final section of the study is devoted to consideration of the possible evidences in Joyce's published works of Freudian analogues or influences. Several of the stories in Dubliners are examined in detail for real or apparent use of Freudian apparatus, and a similar though eclectic study is made of the later prose works. There can be no question that Joyce's primary source for the analytic probing of character was his empirical observations and evaluations of actual persons and his wide and deep knowledge of literature of all times. The Zeitgeist, impregnated as it was with the new psychology, also made its contribution. But there is also an interesting body of evidence that tends to show Joyce's auxiliary acquaintance with the work of the psychoanalysts, possibly dating from the writing of Dubliners. The evidence grows clearer in the subsequent works and emerges irrefutably in Finnegans Wake.

337 pages. $4.35.

THE NEW YORK NOVEL: A STUDY IN URBAN FICTION

(Publication No. 25,427)

Eugene Arden, Ph.D.
The Ohio State University, 1953

The clearest impression we get from novels of New York life is that they deal not with one but with two cities—contradictory in their natures, yet existing side by side with equal vigor. For well over a century, American novelists have designated New York as a place-name symbol for new opportunity, wealth, and power; yet at the same time other novelists have pictured New York as a gathering place for all the depraved and frustrating influences in American life. Writers could invoke either image of the metropolis, playing at will on the rural American's yearning for wider horizons and a more exciting tempo of life, or on his fear and distrust of the great evil city waiting to corrupt his innocence.

This "split vision" of the city led to two chief types of New York novels. In one, romance and optimism were the keynotes; the city represented a battleground where intrepid heroes overcame obstacles and achieved success. In New York's actual wealth, power, and growth, the romantic novelists found a kind of empirical basis for their attitude toward the city. But the less pleasant realities of metropolitan life led to a very different characterization of New York, that of the archetypal "evil city." The materials for realistic and embittered novels were abundant, and with Dickens as a model, something new started to appear in the 1840's and 1850's. New York vice, intemperance, and poverty were first exploited in cheap, sensational fiction, but led to one of the earliest schools of American realism, crude and tentative as that realism may have been. It was a literature of protest, and though expressed in melodramatic terms, it was based on a surge of real compassion for New Yorkers who were victimized by the conditions of their own city.

It is only in the light of these two antithetical attitudes toward the city that we can understand what a New York novel is. The important action of such a novel takes place in the city, of course, and the setting frequently suggests a nervous vitality and continuous struggle. The characters are purposely heterogeneous in type, occupation, race, and religion, and they almost always include a protagonist strange to the city—whether from a rural area or from Europe. Fundamentally, however, these novels display a definite social attitude toward the metropolis, ultimately in support of either the "evil city" or the "promised land" view of New York.

The novels of the "evil city" type embodied three major charges against the city. New York culled the flower of rural youth, only to blight it; tales of opportunity and success were mere delusions, for life in New York generally proved more bitter and degrading than the restless villager could possibly imagine. Realistic accounts of urban hardship abounded in such novels as Osgood Bradbury's The Gambler's League; or, The Trials of a Country Maid (1857), Charles Morris' Honest Harry; or, The Country Boy Adrift in the City (1882), and Benjamin Appel's The Power-House (1939). Another class of novels pointed out that even material success in New York was not an unmixed blessing, for the aspirant had to adopt the predatory ways and acquisitive values of the city or else perish. The price of success, in other words, was one's ethics, or one one's very soul. Ellen Olney Kirk's Queen Money (1888), Charles Dudley Warner's A Little Journey into the World (1889), Edith Wharton's The House of Mirth (1905), and Upton Sinclair's The Money-Changers (1908) all testified eloquently to that point of view.

The final major charge against New York was that its incredibly corrupt politics had a destructive influence on all other departments of the city's life. Early New York novels, if they noticed politics at all, tended toward obvious burlesque, as did, for example, Cornelius Mathews' The Career of Puffer Hopkins (1842). But soon after the exposure of William Tweed, New York fiction began to show a marked and serious interest in corrupt politics. J. F. Hume's Five Hundred Majority (1872) attacked Tammany Hall violently, as did Henry Harland's Grandison Mather (1889) and Edgar Fawcett's A New York Family (1891). The best of the political novels were Paul Leicester Ford's The Honorable Peter Stirling (1894), which was based on the daily practicalities of machine politics, and David Graham Phillips' Susan Lenox (1915), which ably exposed the links between politics and prostitution.

A more cheerful view of life in New York characterized the novels of Brander Matthews, H. C. Bunner, Thomas Janvier, and F. Hopkinson Smith, all of whom were interested in "the individuality, the picturesqueness, and the charm of New York." The novels of Brander Matthews in particular assumed the attitude of experiment, attempting to do for the great American metropolis what other novels had done for the great European metropolises. A Confident Tomorrow (1899), for example, Matthews called his remote imitation of Pendennis. F. Hopkinson Smith's The Fortunes of Oliver Horn (1902) lauded New York's art colony as the only American equivalent of the Latin Quarter in Paris or the Ratskellers in Munich and Düsseldorf.

Many New York novels dealt specifically with the various semi-assimilated "colonies" scattered about the city. In the garrets of Greenwich Village artists, the overflowing tenements of Harlem Negroes, and the ghettolike settlements of European immigrants, one could—in Konrad Bercovici's phrase—"go around the world in New York." These islands unto themselves have done much to make

The items following each abstract are: the number of manuscript pages in the dissertation, its cost on microfilm, and the Library of Congress card number. Enlargements 5-1/2 x 8-1/2 inches, 4 cents per page. No postage is charged if check or money order accompanies order.

New York and the body of fiction about it appreciably different from all other cities and all other city novels; tensions which were either unknown or unimportant elsewhere became critical in the New York novel.

The immigrant was the first of these three types to loom large in urban fiction. Wearing his bright scarves and peasant boots, maintaining Old World customs, he was a figure of local color as early as the 1890's. In his overcrowded tenement dwellings, he caught the attention of such reformer-journalists as Jacob Riis. Because of his ignorance of electoral procedure, he was sometimes pictured as the hapless tool of political corruption. To such writers as the Communist Michael Gold and the Socialist Arthur Bullard, the shamefully exploited immigrant represented the wedge whereby all American workers might be unionized and made full share-holders in American wealth.

The image of a "black ghetto"—as used in such novels as Carl Van Vechten's Nigger Heaven (1920), Claude McKay's Home to Harlem (1928), and Countee Cullen's One Way to Heaven (1932)—succinctly indicates the similarities that existed between European immigrants and Harlem Negroes. Though both groups were subject to assimilating influences, they were suspiciously regarded as "alien" by the dominant culture. Extraordinary tensions among the "aliens" grew out of a divided response to environmental pressures. The more "modern" and ambitious newcomers were anxious to enter the "superior" culture and assume its values, whereas the older, stricter school regarded assimilation as a pernicious form of deracination. The problems of the Negro, in this sense, were merely variants of those faced by all outsiders.

The habitués of Greenwich Village—as portrayed in such novels as William Dean Howells' The Coast of Bohemia (1893), Stephen Crane's The Third Violet (1897), and James Huneker's Painted Veils (1920)—were in one important sense different from other colony dwellers. If the city rejected the Negro or foreigner, the artist rejected the city—withdrawing in disdain from its pervasive commercialism and "middle class morality." The Greenwich Villager, too, represented a different class of character, for his withdrawal was an act of will based on a particular Weltanschauung or temperament, rather than on accident of birth or color of skin. This implies that he could return to a "normal" milieu whenever he pleased, rather like rural heroes who came to New York to seek financial success. Indeed, the return to the old homestead proved the happy ending in many New York novels, though statistics showed no such actual drift back to the farm or village.

We find, when we look for relationships between form and content in New York novels, that the stock romantic novel generally used the city as a "setting" in the most conventional sense. It was chiefly literature which looked with dismay on the waste and frustration of New York life, or adopted some variant of that attitude, that managed to convey something of the city's special qualities. As early as the middle of the nineteenth century, realists were exploring the grimmer aspects of New York, broadening the canvas of the American novel and preparing the way for the later naturalists. In time, of course, the disenchanting images of urban poverty and vice became as restricting as the romantic clichés, and a few writers began to experiment with new symbols and techniques. William Dean Howells, in A Hazard of New Fortunes (1890), worked skillfully with the panoramic method in order to encompass the enormous proportions of New York. Ernest Poole, in The Harbor (1915), used the New York waterfront as a symbol of the whole city and all of modern experience, in a manner analogous to Hart Crane's use of the Brooklyn Bridge. John Dos Passos, in Manhattan Transfer (1915), introduced several brilliant techniques to convey a sense of the atomistic quality of metropolitan life. Thomas Wolfe, in the last half of The Web and the Rock (1939) and the first half of You Can't Go Home Again (1940), saw the city as part of the myth of American youth, growth, and strength, and wrote his novels as if reconstructing a vast tribal legend.

New York, then, has served in American thought as London and Paris have served in the English and French. The metropolis has been an imaginative symbol of all the glories and all the evils of urban life in America, and in that that sense the New York novel has added its own significant dimension to our national literature.

262 pages. $3.40. Mic 58-4831

Abstract published by special arrangement with The Ohio State University.

I SEEK FOR TRUTH: A COMPARATIVE STUDY OF MELVILLE'S MOBY-DICK AND PIERRE

(L. C. Card No. Mic 58-1279)

David Hatch Battenfeld, Ph.D.
Stanford University, 1958

Both Moby-Dick and Pierre are explorations of the problem of epistemology with which the nineteenth century was so greatly concerned. Melville and his contemporaries did not succeed in escaping from the previous century's world-picture of a mechanistic, deterministic universe, although this hypothesis offered no explanation for personal human existence, nor for the individual's claim to objective knowledge. Melville, strongly desiring to assert the worth and dignity of the individual, could find no justification for the individual's claim to valid experienced knowledge either in the mechanistic beliefs of his era or in the Calvinistic determinism of his early religious training. He sought an answer by investigating the possibilities of intuitive truth.

Moby-Dick is essentially the story of Ahab, a man who seeks to live by what he believes to be an intuitive absolute truth. He regards the supernatural forces as malevolent or indifferent, and sees Moby Dick as the visible personification of these forces. He fells that if he can kill Moby Dick, he will have asserted the strength of his own personality against the inscrutable powers of creation. Yet Ahab also feels that he has been predestined to chase Moby Dick, that he cannot escape his purpose; therefore, he sees his own will controlled by those forces against which he rebels. Melville presents Ahab as driven by the desire for knowledge, defeated by a brute creature which, as a symbol of the supernatural, is, according to Calvinism and determinism, unknowable. But Ahab errs in trusting only his intuition. He separates himself from the knowledge he can derive from reason and sense experience. Had he been able to understand his own experiences, he would have seen that his feeling about Moby Dick was an illusion, not a true intuition; but he confuses intuition with instinctive

desire. By depending entirely upon instinct, he forfeits his rational powers; thus his own sin makes his destruction inevitable.

Pierre begins by presenting a character for whom an intuitive truth seems to agree with experience. Pierre believes that Isabel is his sister both on the basis of his feelings and of her evidence. Had Melville followed this pattern, Pierre would have become a martyr, destroyed by the world for following Heavenly truth. But Pierre comes to doubt his feelings, and to distrust his understanding of his experiences. Finally he reaches the position that all experience is purely subjective and so without meaning. In this position, he becomes like Ahab, hating and attacking the powers that have created an incomprehensible world. And like Ahab, by abandoning his judgment, he destroys himself.

Melville succeeds with Moby-Dick largely because he maintains a consistent attitude throughout the book separate from that of Ahab. Melville provides a basis in experience and reason for understanding and evaluating Ahab's actions. Pierre fails because Melville abandons his original attitude, which is separate from Pierre's, and thus he provides no reasonable alternative to Pierre's chaotic subjectivism. 137 pages. $2.00.

CONVENTIONS AND MODERN POETRY: A STUDY IN THE DEVELOPMENT OF PERIOD MANNERISMS

(L. C. Card No. Mic 58-1317)

Jacob P. Blumenfeld, Ph.D.
University of Tennessee, 1957

Major Professor: Robert Daniel

A study of approximately 1500 poems from poets writing in the first half of the twentieth century shows that Modern Poetry has followed the historical pattern of convention-revolt-convention frequently noted by literary commentators.

Revolting against the nineteenth century concepts of the poetic subject and the poetic style, the Moderns expressed impatience with the derivativeness of the Victorians and adopted originality as the watchword of their new poetry. The innovations of the Moderns have become so widely used, however, that they too have developed into conventions which can be attributed to three influences: 1) the search for the fresh and the new; 2) the Zeitgeist; and 3) the specialized audience of Modern Poetry.

The search for the fresh and new led the Moderns to introduce new subjects from modern life to poetry and to write of this subject matter in a vocabulary of modern terms. Thus, a modern, colloquial vocabulary became widely used among the poets of the twentieth century. In their search for the fresh and the new the Modern Poets also attacked traditional metrics, and freedom from traditional forms and experimentation in versification have become characteristic of Modern Poetry. The syntax of Modern Poetry also shows the results of the search for the fresh and new with the Modern Poets consistently sacrificing traditional word order and grammar to achieve greater power and effectiveness.

This impulse to find the fresh and new has encouraged the Moderns to use the symbol throughout Modern Poetry. For the Moderns an image justifies its presence in a poem only by functioning actively to produce meaning, and the acceptance of the idea of the objective correlative has led to such wide employment of symbols that their use has become conventional in twentieth-century poetry.

The Zeitgeist of the Modern Poets has exerted a strong influence on their work. They have become disillusioned and cynical, and reflected this cynicism and disillusionment in the widespread use of the serio-comic in their poetry. Many Modern Poets have adopted the objective and detached tone of the scientific observer in their writing.

The assumption of a special kind of audience of markedly intellectual leanings has led the Modern Poets into the free use of allusion to material from literature, history, philosophy, art, and science that has been perhaps the chief cause of the charges of obscurity levelled at them.

Despite the Moderns' own assertions of originality and the attacks made on them for too-personal, and therefore obscure, symbolism, this study shows that Modern Poetry includes a large body of images that have conventional symbolic values. The Modern Poets continue to use numerous archetypal images, and they also adapt and use non-archetypal images from previous poetry with conventional symbolic values. Some images original to Modern Poetry also come to be used conventionally and with standardized meanings.

The correspondences in the symbolic values among the images examined in this study lead to the modification of certain attitudes about Modern Poetry. Both the obscurity of Modern Poetry and the Moderns' own assertions of originality seem exaggerated.

Modern Poetry can now be seen to have developed conventions relating to poetic composition and the images used in poetry, and it should be apparent that the history of Modern Poetry has repeated the history of its literary fore-runners. The Movement begins as a revolt against rigid poetic conventions themselves the end result of the Romantic Poets' revolt against rigid Eighteenth-Century conventions. Now the Moderns' revolt against this end result has run its course and developed conventions of its own. 221 pages. $2.90.

IN SEARCH OF PERSPECTIVE: A STUDY OF THE SERIOUS NOVELS OF JOHN P. MARQUAND

(L. C. Card No. Mic 58-1386)

Robert Willard Cochran, Ph.D.
University of Michigan, 1957

The purpose of this study is to present a sympathetic reading of the corpus of John P. Marquand's serious novels, to determine whether certain critical commonplaces about Marquand are correct. It is not intended that this study should be precisely an evaluation of Marquand's achievement, but rather that it should be a thorough consideration of Marquand's apparent intentions, irrespective of contemporary trends in the art of fiction.

To this end, the procedure adopted is that of close textual analysis, since Marquand depends on cumulative effect rather than on high moments of illumination to

communicate his meaning. The body of the study is divided into three parts, arranged not in strictly chronological order. First of all, the novels are separated into two groups, according to the success or failure of the novels' protagonists to gain perspective on their lives. Then those novels in which the protagonist succeeds in gaining perspective are arranged in a sequence designed to demonstrate Marquand's refinement of his basic message from novel to novel.

Marquand's contribution to his time is a contribution of didactic message and not a contribution which pushes out the frontiers of technique and expression. His "formula" is the product of admirable craftsmanship, and it has been copied by many younger writers; but, paradoxically, Marquand's technical facility has led to the critics' failure to probe beneath the smooth surface of his work.

The results of this sympathetic study include a conviction that Marquand has played with great variety and impressive subtlety on a major theme, and that he has not, as his detractors claim, simply rewritten one novel. In an age which has found new sociological and psychological tools and in which the great hue and cry is that of insisting on individuality as opposed to increasingly powerful pressures to conform, Marquand insists with wisdom and with remarkable breadth of vision that the individual need not feel confronted with a choice of extremes.

Marquand's novels are an index to our times, for his protagonists are torn between their personal ideals and the dictates of society, but in those novels only when society is so cloying that it positively tyrannizes its members is it not possible for the individual to examine his life profitably. The generic Marquand novel offers the reader a blueprint of the successful life in twentieth-century America. That blueprint includes the acquiring of self-knowledge and the accepting of both himself (not merely resignation) and the influences which have in part fashioned him.

The greatest threat to the individual today, Marquand believes, is the danger of losing his identity and integrity. The Marquand protagonist begins by wondering where he is and why, proceeds through a painstaking and to some extent painful revisitation of his past, and finally reaches a point not simply of no return but of belief in himself.

Because they are victims of their society, George Apley, Harry Pulham, and Willis Wayde cannot permit themselves to achieve perspective, but Marquand carries them to the same moment of potential understanding which the protagonists in the other novels reach. It is characteristic of Marquand that he does not pretend to have "all the answers" for all people. He does, nevertheless, have an answer for people who have their own standards of behavior and who are not victimized by a society whose ready-made standards do violence to their potentialities to become full, understanding human beings. 274 pages. $3.55.

BURKE'S SATIRE ON BOLINGBROKE IN A VINDICATION OF NATURAL SOCIETY

(L. C. Card No. Mic 58-895)

Joseph Boyd Cressman, Ph.D.
University of Michigan, 1957

This thesis is a discussion both of Burke's satire A Vindication of Natural Society and the object of that satire The Philosophical Works of the late Right Honourable Henry St. John, Lord Viscount Bolingbroke. The purpose of this study is to set each of the writings in its proper perspective and to do justice to the ideas of both men. Thus the study developed into an evaluation of the two writings together with, to some extent at least, an appraisal of the men themselves.

Bolingbroke's violent attacks on "artificial theology" are discussed against the background of earlier development such as the development of rationalism in Anglican thought in the seventeenth and eighteenth centuries and the rise and influence of English deism. Bolingbroke's own ideas are analyzed in detail and presented systematically. Evidence from magazine reviews and pamphlets indicate the kind of reception accorded to the publication of Bolingbroke's works in 1754. Similar evidence is presented as to the reception of Burke's pamphlet in 1756. The author analyzes Burke's satire, and discusses the legitimacy of his attack on Bolingbroke, and the evaluation of the Vindication in the eighteenth century and later. Parallels in phrasing between the Vindication and the writings of Bolingbroke are presented in an appendix. Other appendixes consider some related problems, such as the alleged indebtedness of Burke to Rousseau, the defense by Burke and others of prejudices, and some pertinent documents. 403 pages. $5.15.

THE PROBLEMS OF THE RUSSO-GERMANS IN THE LATER WORKS OF JOSEF PONTEN

(L. C. Card No. Mic 58-903)

Wilhelm Dyck, Ph.D.
University of Michigan, 1957

The aim and purpose of this study is fourfold: (1) to investigate Ponten's actual relationship as a literary man to his subject; (2) to show how he presented and interpreted the problems of the various Russo-German groups; (3) to find how much fact and fiction is actually hidden in his presentation of the Russo-German nostalgia for the fatherland; (4) to discover, if possible, the extent to which his intentions in creating Volk auf dem Wege--Roman der deutschen Unruhe have been correctly recognized by his critics.

The dissertation is divided into seven individual chapters. The introduction supplies a biographical sketch of the author and is followed by the history of the novel series and by a brief historical background. Both precede the body of the investigation which treats in full the problems as stated above.

Due to the nature of these problems, a fairly extensive review of Russo-German history is undertaken. Historical facts and literary criticism of Ponten's writings serve

as a basis for the comparative method of study and for the appraisal of Ponten's relationship both to his work and to his critics. The unavailability of some unpublished material in the Ponten archives at Düsseldorf, which are still in private hands, has unavoidably, but not significantly, placed minor limitations upon the extent of this study.

The following conclusions are to be drawn: (1) the author fails in literary continuity and literary architecture because he loses his way too often in a maze of historical and geographical descriptions; (2) by avoiding a discussion of city life, Ponten's picture of the Russo-Germans is incomplete and somewhat outdated, yet the problems of the Russo-German rural colonists, their daily life in work and play, are recognized and portrayed by the author in striking detail; (3) the author's interpretation of the Russo-German Heimats-gefühl, as presented in Chapter VI of the study, is by no means an expression for national reunification with Germany, as many contemporary critics believed, but, rather, is an expression of the attempt of the Russo-Germans to achieve or approach cultural consummation with the West, a culture to which they felt attracted and in which they felt at home; (4) a nationalistic interpretation of Volk auf dem Wege is possible only if one overlooks the author's distinction between the concepts of Volk and Reich. 253 pages. $3.30.

THE DANDIACAL DRAMA: A STUDY OF THE PLAYS OF OSCAR WILDE

(L. C. Card No. Mic 58-1338)

Arthur F. Ganz, Ph.D.
Columbia University, 1957

The catastrophe of Wilde's imprisonment not only terminated his career as a writer but has obscured it ever since. It helped create the legend of Oscar Wilde which has so attracted his biographers that they have largely ignored his works, and very little critical analysis is available. Even a casual study of his plays, however, reveals that they are not the delightful but vacuous entertainments which they are commonly said to be, but works profoundly expressive of the mind and temperament of their author.

I have called Wilde's plays dandiacal because, as his work progresses, the figure of the dandy comes to embody his thought. Wilde was not the first to see the dandy as something more than an arbiter of elegance. In the works of Jules Barbey d'Aurevilly and especially in those of Charles Baudelaire the dandy is seen as an individualist standing against the crass codes of bourgeois society and demonstrating his superiority by deliberately shocking it while remaining unmoved himself. Wilde accepted this vision of the dandiacal individualist and reinforced it with the picture of Benjamin Disraeli, the dandy who could rule an empire.

But individualism, however important, is not the element which makes the Wildean dandy unique. Nor is it his love of exquisite sensations, a feeling derived from Wilde's master, Walter Pater. Above all, the Wildean dandy is the advocate of the supremacy of artistic form. Art was the center of Wilde's life. It was his religion, however inadequate as such, and to Wilde art meant perfect form. The content, particularly the moral content, of the work was irrelevant; form was everything. The great dandiacal joke which appears over and over again in the plays is based on the exaltation of the external, or formal, over the internal. The world of the dandy is based on manners not on morals.

The advocate of such a point of view could not live at ease in Victorian society. Wilde's opinions forced him into the position of an exile, a position made even more unalterable by his sexual tastes. He could not wirte as the ordinary satirist does for, where the satirist admires a social norm and ridicules deviations from it, the Wildean dandy is himself a deviation and ridicules the social norm.

Even in Wilde's first plays, melodramas imitated from Sardou and Victor Hugo, the dandy, though graceful and elegant, is the villain. The Wildean dandy is regularly the villain until Wilde creates an entire dandiacal society in which he can be at home. Salome and the other one-act plays are expressions of Wildean individualism. They are also like extended dandiacal epigrams in being deliberately meant to shock and startle. In the three society comedies the conflict between the dandy and the ordinary society about him is clearest. Each play tells the story of a sinner who is forgiven. This conventional or Philistine element contrasts strongly with the dandiacal, for the dandy is self-sufficient and needs no pardon. In Wilde's masterpiece, The Importance of Being Earnest, he solved his artistic problems by creating a world of pure dandyism where morality does not exist and the dominance of form is complete. 293 pages. $3.80.

JULES SUPERVIELLE

(L. C. Card No. Mic 58-1339)

Tatiana Wolff Greene, Ph.D.
Columbia University, 1957

Jules Supervielle, born in Montevideo in 1884 of French parents, is one of the most admired French poets of the second quarter of the twentieth century. Of him and of Saint-John Perse T. S. Eliot says: "There are no two poets of their generation in France of whose permanence I feel more assured."

Supervielle also wrote novels, tales and six plays. Most of the criticisms of his work treat his poetry, some his stories, a few his plays, but none his novels. This dissertation studies all his works, from the very early, out of print, Brumes du Passé (1901) and Comme des Voiliers (1910) which Jules Supervielle made available to the writer, to the texts of 1956. It is also an attempt at determining what constitutes his originality.

His work is studied first from the psychological, then from the aesthetic point of view. It is the writer's claim that an important author's biography, the study of his main themes, his moods, key-words, symbols, images, dialogue and prosody acquire their full significance for the reader only when he can see their inter-dependence. All those aspects are therefore studied here. Following this, the different "genres" are treated successively; then a study is made of possible relationships with other writers or trends (chiefly with Laforgue and Lautréamont--Two French poets who also came to France from Uruguay--,

Valery Larbaud, Jules Romains, Francis Thompson, Rainer-Maria Rilke, and the Surrealist school).

The evolution of Supervielle's poetics is presented throughout the body of the dissertation and in an appendix concerning variants, for which a great number of texts were found in their pre-original form--a research which had not yet been attempted and which, it is hoped, may afford the reader new insights. Other appendices are: a review of the main critical essays and articles on Supervielle from 1919 until 1956; a frequency list of the keywords in the works in verse; finally excerpts from Jules Supervielle's letters to the writer.

Supervielle's works reflect the ordeals of the twentieth century. Although expressing at times a metaphysical awareness of the absurd and a deep sense of anguish, they insist upon the redeeming value of human sympathy and on a loving fellowship with the smallest as well as with the lartest components of the cosmos. To quote the poet Max Jacob: "Le monde dans un homme, tel est le poète moderne".

Comedy occasionally masks his concern with the tragic elements of life. Yet his works express an ever better understanding of man's torment, as well as a search after the deeper self.

Supervielle's originality lies in his inspiration which confers a new value to our sense of time and space, while it creates many states of the consciousness of the self--from dispersion to an intense concentration. It comes out chiefly in the structure of his images, in the subtle and varied chords which often replace rhymes, therefore in an increasingly distinctive poetic language.

Thus this dissertation, in addition to being the study of writer's works, presents the results of an analysis of poetic expression per se.

This essay is written in French. 731 pages. $9.25.

1. In his Foreword to Joseph Chiari's Contemporary French Poetry, 1952.

THE THEATRE OF MANUEL AND ANTONIO MACHADO

(L. C. Card No. Mic 58-923)

Manuel Henry Guerra, Ph.D.
University of Michigan, 1957

The Theatre of Manuel and Antonio Machado is a study of the dramatic works of the two Machado brothers. Both poets developed the two styles predominant in Spain during their period: the reflective attitude and self-analysis of the so-called "Generation of 98", (Antonio Machado, 1875-1939), and the continuous search for plastic imagery of "Modernismo", (Manuel Machado, 1874-1947). But Manuel and Antonio Machado are universally known for their poetry, while their dramatic production has been generally overlooked or underestimated. The purpose of this study, therefore, is to establish the importance of their early and continued interest in the theatre, as a vital part of their literary career, and appraise the intrinsic value of their dramatic production.

The Machados were among those who were deeply concerned about the state of the Spanish theatre. They rejected the old style of Echegaray, and championed the new realism of Benavente, and, with the latter's encouragement, they engaged in varied dramatic activities to improve theatrical conditions. The Machados published a manifesto of their own dramatic creed and offered it as a statement for the modern Spanish theatre to consider. For example, the Machados believed that the Siglo de Oro theatre held a great source of dramatic material which should be renovated and brought to the modern stage. They combined the techniques and form of the Siglo de Oro, such as asides, monologues, soliloquies, et al, with modern psychology and contemporary ideas of the theatre. Concerning criticism, the Machados also appealed for a benevolent attitude on the part of dramatic critics. The Machados translated Hernani of Victor Hugo. L'Aiglon of Rostand, and Die Räuber of Schiller, and we know for certain that they staged the first two. They adapted and staged El príncipe constante by Calderón, Hay verdades aue en amor, La niñā de plata, El perro del hortelano by Lope de Vega, and El condenado por desconfiado by Tirso de Molina.

Desdichas de la fortuna o Julianillo Valcárcel (1926), a tragi-comedy written in verse, and the first original Machado play, is based on the historical figure of the natural son of the Count-Duke of Olivares, and features the picaresque atmosphere of the seventeenth century. Juan de Mañara (1927) is a modern Don Juan, who, unlike many of his predecessors, is deceived by a woman, only to repent from a life of debauchery and become a saintly legend. Las Adelfas (1928) combines the psychological conflict of dreams with a poetization of Andalusian setting. La Lola se va a los puertos (1929) is an idyllic play which exalts the Andalusian cante jondo. La prima Fernanda (1931) is a political satire which comically treats the subject of the Spanish opportunist. La Duquesa de Benamejí (1932) is a romantic play that combines verse and prose, and features Spanish life under French occupation as well as a noble bandit who fights hopelessly to the end. El hombre que murió en la guerra (written in 1928, but not staged until 1941) is the only Machado play written in prose. It is a philosophical-symbolistic play which dramatizes the conflict between the reactionary order which the father represents and the liberal outlook of the son.

In all these plays, the Machados tried to combine the best of Spanish dramatic tradition, as represented by the Siglo de Oro, with all that goes in making a real contemporary play (i.e., the use of contemporary problems and ideas of the theatre). To some critics, this theatre may seem too literary and not adaptable to the stage. For us, there is in their play production a poetic sweep and a human understanding which brought dignity, beauty, and warmth to the Spanish theatre. 199 pages. $2.60.

TRAGIC IRONY AS FORM: STRUCTURAL PROBLEMS IN THE PROSE OF STEPHEN CRANE

(L. C. Card No. Mic 58-1294)

Will Carragher Jumper, Ph.D.
Stanford University, 1958

Critical opinions of the prose of Stephen Crane have fluctuated between the extremes of adulation and rejection since 1895. This study attempts to examine Crane's prose

works as literary art; to investigate the part played by irony, naturalism, symbolism, impressionism, psychological realism, and journalism on the building of their structure; and to make a critical evaluation of the important stories. Freudian interpretations are rejected with myth-and-symbol speculations as not relating to the criticism of the works themselves.

Theme, structure, and meaning in Crane's prose are seen to be almost wholly dependent upon either verbal or dramatic irony arising out of Crane's stoic humanism: in the indifferent universe the only value of the humanist lies in the identification of the self with its fellow-sufferers--a stoic and self-imposed value. Fellow-feeling and dedication, coupled with self-control in misfortune and pain, are the principles upon which an ordered unity of action may be built. The individual can act within limits, can take a chance on making a choice, even though appearance--subjective vision--is forever at odds with reality--the partially knowable.

Though Crane experimented with naturalism in his early writing, even those works are not completely naturalistic. His exploration of naturalism was precursory, not definitive. By the time he wrote The Red Badge, he had absorbed the lessons of naturalism and had gone on to his own approach.

His symbolism, deriving from the Bible and from evangelical interpretations, consists of identification of an immediate observation with its larger connotations or of a striking image with its emotional reverberations. He was not the pioneer of symbolism, but he was the first to integrate symbolism into the new realistic tradition and to give it its typical American form.

A self-identified impressionist, Crane used all the devices of impressionism as developed in the literary and visual arts. He adapted associationistic psychology to narrative technique, including limited point of view, rigid selection, and affective deformation of reality; he aimed at a "higher realism" by placing his viewpoint character at the heart of the battle. Crane's subject matter and methods came largely from journalistic content and style, but he went considerably beyond these backgrounds, especially in prose style. He overthrew 19th century prose without consciously rebelling; he was only trying to be unmistakable.

Crane's "permanent" works are "The Open Boat," The Red Badge, "Death and the Child," "The Price of the Harness," "The Upturned Face," "Virtue in War," and "War Memories." Good, though marred in one way or another, are "The Blue Hotel," "The Bride Comes to Yellow Sky," "The Clan of No-Name," "The Monster," "A Mystery of Heroism," "An Episode of War," "The End of the Battle," "The Five White Mice," and other lesser stories and sketches in Whilomville Stories and Midnight Sketches.

On their own merits, and aside from their historical importance, Crane's works place him in the second rank of American fictionists, well below Hawthorne, Melville, and James, but with Howells and Clemens, and above Poe. His philosophical orientation proscribed theme and subject matter; his insistence upon direct experience isolated him from tradition and vicarious learning. But his narrowness, intensity, and sharp focus on thing, event, and motive lent him compelling power. Crane's fiction does not embrace the sweep of Western culture, the complexity of manifold human activity, nor the triumph of justice and mercy; it does demonstrate the consummate value of human dignity and human feeling in the face of man's tragic dilemma. It is this demonstration, occasionally perfectly embodied in artistic form, that will make Crane permanent.

298 pages. $3.85.

THE USE OF NOVELISTIC ELEMENTS IN SOME SPANISH-AMERICAN PROSE WORKS OF THE SEVENTEENTH AND EIGHTEENTH CENTURIES

(L. C. Card No. Mic 58-940)

Walter Duane Kline, Ph.D.
University of Michigan, 1957

Although no novel was written by native Americans in the Spanish colonies, there was an abundance of prose employing fictional elements. It is the purpose of this dissertation to study fifteen of these works, to analyze specific techniques of each author, classify themes developed through novelistic elements, and establish relationship between these works and contemporary Spanish writings. Ten of the works are by Creoles or mestizos; five others are by peninsulars whose works were inspired or written in the New World.

Novelistic elements include fictional devices showing imagination, either in over-all plot structure, or in scattered episodes employing suspense, dramatic action, dialogue, colorful descriptions and illustrative anecdotes. These elements were generally used to vitalize the work's utilitarian purposes, and fall into four main categories: (1) Those depicting the drama of adventure and heroic struggle with American reality in which suspense, epic descriptions and psychological penetration of character extol man's virtue, honor and bravery or idealize the native and his customs. Studied in this group are Inca Garcilaso's La Florida del Inca (1605) and Los comentarios reales (1609 and 1616); Catalina de Erauso's picaresque Historia de la monja alférez (1625), Los infortunios de Alonso Ramírez (1690) by Carlos de Sigüenza y Góngora, and Francisco Núñez de Pineda y Bascuñán's El cautiverio feliz (c1665). (2) Those used in the pastoral novel, in which shepherds expound philosophies of love and nature or engage in horseplay in the abstract setting of Bernardo de Balbuena's El siglo de oro en las selvas de Erífile (1608) or turn pastoral techniques to Catholic didacticism with their discussions of the Immaculate Conception and Marian praises in Los sirgueros de la virgen (1620) by Franciso Bramón. (3) Those elements presenting the Baroque concern for morality and didacticism like the allegorical dream of Juan Palafox y Mendoza's Pastor de Nochebuena (1660), Joaquín Bolaños' use of dialogue, personification, and anecdotes to teach preparedness for death in La vida de la muerte (1792), or the picaresque tales of Calderonian intrigue showing the evils of immorality in El carnero (c1636) by Juan Rodríguez Freile. (4) Those satirical elements like those in Sueño de sueños (c1775) by José Mariano Acosta Enríquez who revives Quevedo, Torres Villarroel and Cervantes for a trip through the realms of Death. The wit of the Guatemalan lawyer, Antonio Paz y Salgado, analyses lawyers and clients (Instrucción de litigantes, 1742) and satirizes loquacious character types (El mosqueador..., 1742). The same ridicule is found in Esteban Terralla y Landa's

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concise diary of a Lima fop (Vida de muchos o sea una semana bien empleada..., 1790), while Alonso Carrió de la Vandera gives the sharpest satire of social types, governmental officials and clerics in his dialogues with Concolorcorvo in El Lazarillo de ciegos caminantes (1773).

These works reflect in their novelistic aspects the literary trends popular in Spain: seventeenth-century idealization of the hero, Baroque moral preoccupation, eighteenth-century attitude of criticism and satire. However, these New World writers did not follow their peninsular contemporaries in expressing their Weltanschauung through long fictional works, but chose to produce a utilitarian literature in which imaginative elements were interspersed among treatises on morals, ethics, theology, government, economics, and industry. This dissertation does not attempt to explain this phenomenon, but merely to point out its existence. 346 pages. $4.45.

ALDOUS HUXLEY'S NOVEL OF IDEAS

(L. C. Card No. Mic 58-943)

Alden Dale Kumler, Ph.D.
University of Michigan, 1957

The purpose of this study is to analyze the methods employed to give the reader the sense of adequate development of character, plot, and verisimilitude in Aldous Huxley's novels of ideas, that aim to reveal the nature "of each personage ... as far as possible in the ideas of which he is the mouthpiece." Of secondary importance is the effort to discover how the author's particular thought is introduced and differentiated from that of his characters. To the critic, the novelist of ideas seems to face the aesthetic problems of reconciling the conventional demands made upon his art form with the special emphasis his genre is designed to give to talk and ideas. The method used throughout the study is that of critical analysis.

Chapter I deals with the antecedents and development of the novel of ideas as distinguished from the philosophical and "apprentice" novels. Thomas Love Peacock in his "dialogue" novels is one progenitor acknowledged by Huxley. The works of Peacock and later those of William H. Mallock and Norman Douglas appear to suffer from uneven characterization, inadquate plot, and failure of verisimilitude. Not only is he in the tradition of these authors of novels of talk, but Huxley's mature work shows influences of two French writers, Remy De Gourmont and André Gide, particularly in the matter of technique based on musical analogies.

Chapter II presents what the critic may discern as solutions for the aesthetic problems in the early novels, Crome Yellow and Antic Hay. In these, characterization shows some development by multiple methods. Both possess a conventional plot although in the capsule form of a time miniature. In addition, literary patterns based on dance routines in part supplant or reinforce plot.

Chapter III shows the use of a literary form analogous to the fugue in music in developing the characterization, plot, and verisimilitude of Point Counter Point, Huxley's most elaborately structured novel. In addition to vivifying conversation, the author employs a full complement of multiple devices of characterization, including background and personality sketching, periodic reinforcement, author analysis, and cross-lighting. Seven contrapuntal plot strands make many opportunities for thematic variation. Verisimilitude is heightened by advanced techniques for multipersonal revelation of the "new" subjective reality. The literary convention of the raisonneur is used to introduce and distinguish author philosophy.

Chapter IV treats of the gradual decline, as seen in the novels from Brave New World to The Genuis and the Goddess, of the maintenance of the conditions necessary for a balanced, democratic, and nearly simultaneous consideration of multiple viewpoints required for the peculiar aesthetic pleasure of the novel of ideas. Rather than stressing the poise and equilibrium of many different concepts, the materials of the later novels seem increasingly to be shaped to satirize the views hostile to the particular solution the author wishes to present for the human dilemma.

Chapter V draws two general conclusions. 1.) The literary pattern based on the fugue, in which one voice may be heard in independent statement simultaneously with several other different melodies, is a device ideally suited to mirror the intellectual chaos of many diverse philosophies in an era of flux such as were the 1920's as pictured in Point Counter Point. 2.) As the author turns in his later books to shaping materials in satire of views antithetical to his own or to promulgating a personal solution for the ills of the world, he departs from the requirement that seems necessary for the novel of ideas--the drama of their balanced presentation--and becomes instead a tractarian for a single idea. 283 pages. $3.65.

SAIKAKU: NOVELIST OF THE JAPANESE RENAISSANCE

(L. C. Card No. Mic 58-1344)

Richard Douglas Lane, Ph.D.
Columbia University, 1957

The Japanese prose fiction of the early and mid-seventeenth century is known as kana-zōshi. It embraces a vast world of content: romances of love, myths, allegories, parodies, fictional guidebooks, epistolary tales and letter-writing guides, rogue and travel novels, and even philosophical or religious tracts and tales.

It was Ihara Saikaku (1642-1693) who shaped from the varying forms and subject matter of the kana-zōshi an artistic whole. His creation was a new genre of largely realistic novels and short stories, which flourished for a full century, and came to be known generically as the ukiyo-zōshi, or "Booklets of the Floating-world."

Saikaku was born and passed most of his life in Osaka, the fountainhead of the new bourgeois culture, and already the commercial center of Japan. His social origins are uncertain, but whether his father was rōnin (disenfeoffed samurai) or chōnin (townsman), Saikaku himself was a man of the people, the first great popular writer of the Edo Period (1600-1868).

Saikaku's literary training lay primarily in the unconventional, realistic haikai poetry of the Danrin School, and when he wrote his first novel in 1682 he was already forty years of age. All of his more than twenty-five volumes of novels and short stories were produced in the last eleven years of his life.

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Saikaku's fiction may be most conveniently summarized in the following categories:

The love novels. The first and most important group of Saikaku's novels consists of those works which take as their central theme love affairs, or a depiction of life in the demi-monde. These novels constitute the major part of Saikaku's writing during his first five years as a novelist, 1682-1686, and the theme recurs often in his later stories.

Legendary tales. Collections of legends and tales form another small, but important part of Saikaku's writing.

Samurai tales. Another quite distinct group of Saikaku's fiction is comprised of those stories treating of pederastic love, loyalty, and vendettas, particularly among the warrior class.

Townsman stories. The works that occupied much of the last five years of Saikaku's life, 1688-1693, consist of stories devoted to the everyday life of the townsmen. Although Saikaku's earlier novels and stories had made frequent use of the townsman as protagonist, now practically the whole stage is thus occupied, including a minute description of the townsman's everyday business-life--rather than concentrating on his love-life as had so many of Saikaku's earlier works.

When we scan the totality of Saikaku's oeuvre, a general pattern will be perceived. He wrote first of the emotional and sex life of the upperclass townsmen, particularly in the world of the licensed quarters; then of love and passion among bourgeois girls and women; next he described the ideals and actuality of pederasty, both among the samurai and the townsmen, together with the vendettas of the warrior class. Finally he turned to the everyday economic and social life of the middle-class townsman, and stories on this theme dominate his later years. A few works lie outside this pattern, which, nevertheless, represents a valid outline of Saikaku's changing interests and changing personality during the eleven brief years of his life as a novelist.

One cannot but be impressed by the variety of content and the humanitarian breadth expressed in Saikaku's writing. Involved plot construction was never Saikaku's forte, but in his own context he is the greatest realist Japan has produced, well able to stand with Boccaccio, Rabelais, Defoe.

The Appendix to this dissertation includes an account of of Saikaku's literary contemporaries and followers, and a comprehensive bibliographical study of Saikaku's prose works. 417 pages. $5.35.

THE NOVELS OF L. H. MYERS

(L. C. Card No. Mic 58-1087)

John Francis Lauber, Ph.D
University of Washington, 1957

The primary purpose of this dissertation is to criticize in detail the novels of L. H. Myers, giving attention both to the ideas he expressed and to his aesthetic achievement. The secondary purpose is to "place" his work in the tradition of the English novel by relating his novels to the genre of the novel of ideas and by comparing them to the work of certain contemporaries whom Myers significantly resembles.

Chapter I outlines Myers' life. He was born in 1882, into a wealthy, upper-middle class Cambridge family. His life was devoted to writing, although he published only seven novels. Those included in The Near and the Far (1929-1940), a tetralogy set in sixteenth-century India but which deals with philosophical, religious and social issues of permanent significance, constitute his principal achievement.

Chapter II studies the novel of ideas as a literary form and briefly traces its development in English literature from the eighteenth century to the present. It is defined as the novel which gives an important role to abstract ideas, which deals directly with ideas through the discussion of its characters, but which differs from the philosophical dialogue by embodying these ideas in completely realized characters and by working out their consequences in action. It is pointed out that the typical weakness of the novel of ideas is a failure to integrate ideas and fiction, and that Myers avoids this danger more successfully than any other English novelist of ideas.

Chapters three, four, five and six criticize Myers' novels in chronological order, and chapter seven investigates the literary and philosophical sources of The Near and the Far, considering particularly Walter Pater's Marius the Epicurean, J. H. Shorthouse's John Inglesant, and the philosophical works of Martin Buber and John Macmurray. Chapter eight summarizes Myers' accomplishment and compares him to certain of his contemporaries, including Woolf, Huxley and Forster.

Myers' principal concern is with the nature of successful personal relationships, the keys to which he finds to be equality and complete candor between the persons involved. Solution of social problems depends on the wider application of these principles, and even the relationship between man and God should follow them. His criticism of modern civilization, expressed in all his novels, derives from his belief that its materialism, its vulgarity, its triviality and its class-distinctions make truly personal relations almost impossible. His thought clearly reflects the influence of Buber's I and Thou and of the writings of John Macmurray, an English theologian who attempted to synthesize Marxism and Christianity. Myer's concern with the expression of his ideas apparently excluded interest in technical experiment, but although all of his novels are traditional in form, a chronological survey indicates his steady development as a novelist--the increasing ease and appropriateness of his style, the growing fullness and variety of his characterizations, and above all his greater ability in The Near and the Far to dramatize his action through effective scenes.

Chapter nine explains Myers' surprising obscurity by the absence of popular appeal in his work, by his apparent unconcern for the immediate problems or the day, by the traditional form of his novels, and by his avoidance of literary cliques and his personal reserve. The only serious criticism of his work has been by F. R. Leavis, D. W. Harding and G. H. Bantock. Their criticism, however, tends to concern itself with moral and philosophical issues to the neglect of aesthetic considerations, and a fully adequate criticism of Myers must include recognition and demonstration of his considerable artistic achievement. 296 pages. $3.80.

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BALDOMERO FERNANDEZ MORENO: HIS LIFE AND WORKS

(L. C. Card No. Mic 58-1426)

Clara Jean Leith, Ph.D.
University of Michigan, 1957

Baldomero Fernández Moreno (1886-1950) was a writer of lyric poetry and prose for thirty-five years in Argentina. During this period his work became known to all literate Argentines as well as to other Spanish-speaking people. The high esteem with which Fernández Moreno was regarded by his contemporaries is demonstrated by the numerous honors and prizes which were bestowed upon him. His life and his works are closely related, and therefore it is difficult for them to be considered as separate entities. Although much has been written about the poet in Spanish, there is a dearth of information concerning him in English. The purpose of this study is to provide, in English, biographical data and a study of the published works of Baldomero Fernández Moreno which represent best the enduring qualities of the poet.

Born in Argentina of Spanish parents, he spent six years (1893-1899) of his early childhood in Spain, where his formal education was begun. The remaining years of his life were spent in Argentina. His life spanned a period of great activity and change in the field of Argentine poetry, including the zenith of modernism under the inspired leadership of Rubén Darío, its subsequent waning during the period of transition from modernism to vanguardism, and, finally, the poetry of the present day with its tendency toward greater independence of individual poets and an almost total absence of "schools." A doctor of medicine by virtue of his formal training, and a lyric poet by choice, Fernández Moreno did not allow himself to be tempted to deviate from the course of action which he had planned for himself. His position is a unique one among the poets of his day. Impelled by his desire to write poetry, he decided to relinquish a fairly successful career in medicine in order to devote more time to the writing of poetry. Thereafter, he taught in secondary schools.

In order to facilitate the study of his life and works, a division into three periods has been made, designated as (1) Early (1886-1924), (2) Middle (1925-1937), and (3) Late (1938-1950). His works follow closely the pattern of his life with which they are indissolubly connected. By means of them we know how the poet felt about whom and what he saw. His bestowal of poetic hierarchy upon people and objects previously disregarded was one of his outstanding achievements. In this respect he was without precursors. His themes were those of poetry, life, and death, which, for him, were interdependent. The moods expressed by the poet were those of joy, sorrow, and ironic humor. In the matter of introducing ironic humor into his poetry, Fernández Moreno may be considered to be an innovator in the realm of Argentine poetry. The poet was an impressionist of the first order. This is evident in the manner in which his creative imagination treated the innumerable persons, objects, and places with which the poet had had some association. It is likewise discernible in his attitude toward language. The latter is invariably simple, precise, and yet suggestive of more than is expressed. Fernández Moreno demonstrated a preference for traditional Spanish forms--strophic and metric--and for rhyme, although he was able to write well in all forms. His favorites were the décima, the seguidilla, the romance, and the sonnet among the strophic groups. The octosyllable, the hendecasyllable, and the Alexandrine were his preferences as to meter.

The qualities of the poet which give promise of surviving the test of time are lyrism, simplicity, sincerity, and versatility. 207 pages. $2.70.

THE SEA NOVELS OF WILLIAM MCFEE

(L. C. Card No. Mic 58-958)

Donald Maynard Martin, Ph.D.
University of Michigan, 1957

The purpose of this study is to determine William McFee's contribution to the development of the sea novel. Before a study of his work was begun, it was necessary to examine the history of the development of the sea novel in order, first, to determine the elements of this type of fiction as they were evolved historically, second, to establish perspectives to facilitate the understanding of McFee's fiction, and, third, to clarify McFee's relationship to the pattern of sea fiction developed by his predecessors.

Chapter I contains a brief survey of the history of the development of the sea novel. It discusses the fiction of such recognized sea novelists as Defoe, Smollett, Cooper, Marryat, Melville, and Conrad, with whom the chapter ends, and it endeavors to show that each writer contributed to the development of the sea novel.

Chapter II begins the study of McFee's fiction with a discussion of six of the eleven novels. The six main characters are all Englishmen, bred to steam, and, with one exception, officers in the merchant marine. Although each novel covers a limited period of time, as a group the novels extend from about the turn of the century to a midpoint in World War I. Of the two dominant influences in the seaman's life, the sea and the shore, the emphasis in these novels is upon the sea. Romantic love and its illusions complicate the seaman's age-old dream of a snug billet ashore. The seamen's unsuccessful experiences with romantic love reveal that the homely slogan, "Stick to the ship," is a vital phrase which indicates the safety, security, and sanity of maritime life.

Chapter III continues the study of McFee's novels with a discussion of the remaining five novels. The five main characters, whose mature lives as a group span the time from a decade or so before World War I to the middle 1930's, are again all Englishmen, bred to steam, and, with the one exception who is a chief engineer, commanding officers of luxury vessels operated by old and established lines. The author employs a narrator for four of the five novels, a chief engineer who is a contemporary and colleague of the seamen whose adventures he tells. The age-old dream of the seaman is still as potent as ever, but the dream is complicated by the fact that life at sea after the First World War has been drastically changed. The change was brought about by the industrialization of the maritime world. As a result of their failure to adapt themselves to the new conditions, two of the main characters perish, the third retires to the jungle, the fourth survives damaged in character, while the fifth returns to his first love, the land.

Chapter IV contains the conclusions. (1) McFee is our

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first significant writer of sea fiction in the Age of Steam. In his sea novels he has confined himself exclusively to the peculiar duality in the seaman's life between the sea and the shore, a relationship of primary importance since the advent of steam. (2) The Age of Sail, which came to an end with Conrad, has little, if anything, in common with the Age of Steam, since the industrialization of the maritime world not only relegated the Age of Sail to a cherished memory, but also created problems never encountered by the seaman bred to sail. (3) McFee's particular contribution to the development of the sea novel lies in his depiction of a phase in the evolution of the mechanically propelled vessel. That phase is portrayed in the lives of a group of seamen who, reared in a period of comparative simplicity, cannot adjust themselves to the profound and complex changes in the maritime world of their maturity.

238 pages. $3.10.

DON JUAN MANUEL, EL CONDE LUCANOR: AN EDITION ACCORDING TO MS E OF THE ACADEMIA DE LA HISTORIA

(L. C. Card No. Mic 58-1089)

Rigo Mignani, Ph.D.
University of Washington, 1957

The purpose of the present work is to present, in its entirety, the version of the Conde Lucanor contained in MS E of the Academia de la Historia in Madrid, unpublished and only partially known until now. Because at the present moment the studies on the manuscript tradition of Juan Manuel's works and even more those on the Castilian language of the 14th Century are far from advanced, the only contribution to be made toward the establishment of a critical text of the Conde Lucanor is the publication of the extant MSS which would remain, otherwise, available only to scholars in Madrid. Of the five (5) MSS of the Conde Lucanor that we possess, only two (2) have thus far been published.

In the present edition, I have retained all the graphic peculiarities of the MS. The footnotes carry all the errors and omissions of the original in order to offer as faithful a picture as possible of MS E. The text has been emended, whenever necessary for the meaning, with the help of all the other MSS available to the editor in microfilm.

The introduction reviews the present conditions of the studies on Don Juan Manuel and includes a short biography, an examination of the scholarly editions of his works, the conclusions of the most recent studies on his style and sources, together with an attempt to evaluate the position of MS E within the manuscript tradition, and explanatory notes for the use of the present edition.

A Glossary of the most uncommon words of medieval Spanish found in the text is added at the end.

299 pages. $3.85.

A CRITICAL SURVEY OF THE POETRY OF THOMAS EDWARD BROWN (1830-1897)

(Publication No. (25,457)

Raymond Everett Mizer, Ph.D.
The Ohio State University, 1952

Thomas Edward Brown was born in Douglas, Isle of Man, in 1830. He was educated at King William's College, on the Island, and at Christ Church, Oxford. His academic record was brilliant, and he became a Fellow of Oriel College. After leaving the University, he served as Vice-Principal of King William's and Head of the Crypt School, Gloucester, before going to Clifton College in 1863 as second master and Head of the Modern Side. Here he remained for nearly thirty years, during which time he wrote and published the bulk of his poetry. In 1892 he retired to the Isle of Man and devoted the five remaining years of his life to reading, to his poetry, and to a series of lectures and articles setting forth the conclusions drawn from his encyclopaedic knowledge of Manxiana.

The greatest personal crises of his life were the death of his son Braddan in 1876 and of his wife Amelia (Stowell) Brown in 1888. In 1885 he had been ordained a priest in the Anglican Church. Despite his long service as a schoolmaster, he was not a born teacher, and often chafed under the routine and restrictions of his office. Always a confirmed nature lover, he retained throughout his career a nostalgic longing for the shore and the mountains of his native island. England never wholly ceased to be a place of exile.

Brown's published letters, most of which were written after 1873, are of interest in their own right, and contain vigorous and original commentary on people, books, and ideas. Something of the complexity of his personality shows through the shifting variety of style -- now abrupt and caustic, now melancholy, now whimsical, or bubbling over with boyish fun. He wears his scholarship and erudition lightly, but it becomes apparent, not only in the depth and incisiveness of his comments, but in the liberal sprinkling of Greek, Latin, or any of a half dozen modern languages. His keen sense of humor, his penetrating observation, and his feeling of intimacy with nature give these letters a freshness which time has not destroyed. Their variety and unpredictability in content and tone is their most characteristic element.

One specialized interest of the letters is the literary criticism embodied in them. Brown was not a methodical or systematic critic, but his off-the-cuff judgments on an astounding array of books and authors, ancient and modern, provide valuable insights into his sense of literary values. His taste was catholic in the extreme, modified by scholarship and what Arthur Quiller-Couch called "lambent common sense." He demanded reality, consistent characterization, organic form, sincerity, freedom from morbidity and insolence. His criticism is often wayward and impulsive, but it is always fresh. One critic described this quality perfectly when he said that Brown approached a book as though he were the first man to open the covers.

Three-fourths of Brown's poetry—at least 20,000 lines—is narrative verse. Most of this is written in the Anglo-Manx dialect, a combination of a modified Manx-Gaelic and homely, colloquial, vernacular English. Beginning with Betsy Lee in 1872-3, Brown published a series of yarns, or stories in verse, known collectively as

Fo'c's'le Yarns. They take their title from the setting in which they are told: an old sailor spinning yarns to a group of men seated on the fo'c's'le of his ship. The first series, published in 1881, contained four major poems, including "Betsy Lee," "Christmas Rose," "Captain Tom and Captain Hugh," and "Tommy Big-Eyes." The second series, entitled The Doctor and Other Poems followed in 1887, and contained, in addition to the title poem, "Kitty of the Sherragh Vane" and "The Schoolmasters." The third and final series, The Manx Witch and Other Poems was published in 1889, and included the title poem, "The Indiaman," "The Christening," "Peggy's Wedding," "Mary Quayle," and "Bella Gorry." Most of these had appeared earlier in serial form in periodicals, and several of them went through more than one edition. There is nothing else quite like this body of narratives in all of English poetry. Their singularity derives from three primary factors: the intent and purpose of the poet, the nature of the material, and the style and manner in which he has presented that material.

Brown's aim was to build "a cairn of memories." The way of life peculiar to the Isle of Man was vanishing, and he proposed to make of his poems a Court of Record in which Manx family traditions, tribal traditions, customs, folklore, character types, dialect, legend, superstition, and all the other things that gave the Manx people their individuality might be preserved. His passion for continuity led him to explore for his people "the ancient springs of faith and custom." Thus it is that the ancient heritage of Manxland in its manifold aspects provides the basic subject matter for these yarns. He reworked and retold its anecdotes and legends, re-enacted its comedies and tragedies.

The current scene has little reflection in these yarns. He had little interest in science, as such. Politics interested him not at all. His notions on economy in its technical sense are rudimentary. With moral and spiritual values, on the other hand, his concern was vital and functional. Almost everything he wrote is touched in some way by his religious beliefs and attitudes, not with the denominational or sectarian squabbles of his time, but with the universal and timeless questions of man's relationship to man, and to his Creator. His principal task here was to record and interpret the Manx character, and in so doing he painted a region hitherto unknown to literature. He had no important predecessors as poets of the Isle of Man, and he has had no successors. Inextricably mixed with the historical and legendary material are the impressions of his own personal observation. The factual has been so modified that it is now fiction; the fiction has so taken on the garments of actuality that it passes for fact.

The personality of the narrator, Tom Baynes, becomes a central factor in these stories in verse. Brown turns him loose to spin his yarn in his own way. Baynes's limitations, his prejudices, his burly good humor and softheartedness, his proclivity to repetition and digression and laconic comment—these are the very bone and sinew of the yarns. For these are dramatic monologues, in which the narrator is fully as important as the story itself. Baynes is much more than a mere narrator; he is a typical or representative figure, the incarnation of the Manx genius. It will not do to take too seriously Brown's self-identification with this rough-and-ready sailor. He was everything that Tom Baynes was, but he was much more besides. Had the two been identical, we might have had the Fo'c's'le Yarns much as we have them now; Brown went on to write the lyrics. Certainly Baynes is a partial embodiment of the poet as he saw himself, and a representative of the Manx people, but he emerges also as a distinct individual, full-blooded and confident. He strides through Brown's pages with all the self-assurance of a Jorrocks or a Sam Weller, but with a much more realistic approach to life. He has had a checkered and colorful career, and it is his experiences, his reactions to them, his interpretation and commentary upon them, that he pours out in profusion in these years. It is no exaggeration to call him one of the major achievements of sustained character portrayal to be found in nineteenth century narrative poetry.

Brown has a flair for picturesque verbal arrangements, the unexpected word or phrase, sharp contrasts in diction. He loved to cap a Homeric simile with a slang phrase, or a homely colloquialism. These verbal acrobatics are normally refreshing and apt, but now and again we sense a straining after the unusual. We must also be prepared for sudden shifts of tone; from pathos or sentimental reverie he can swing off in a single line and bring us to laughter.

The dialect in which these yarns are told is not a choice instrument of the Muses, but Brown used it with great skill and variety. It conveys accurately the native accent and idiom, and contributes notably to the unique flavor of the yarns. The diction is typically colloquial and innocent of grammatical niceties, vigorous and earthy, with generous dashes of slang and mild euphemistic oaths and exclamations, but no profanity. There was both archaisms and neologisms, the former appearing most often in connection with his frequent use of Biblical quotation or paraphrase, and the latter more commonly in humorous or satiric passages.

With two exceptions, these yarns are written in what Brown called "asynartete octosyllables." This is basically a very simple metrical form, the rhyming couplet with four beats to the line. Sometimes the lines alternate between iambic and trochaic, but he varies the rhythm so constantly that only careful analysis will verify the pervasive dominance of the iambic beat. He has taken great liberty with the number of unstressed syllables, adding or subtracting them almost at will, just as he substitutes freely for the iambic foot. This was an extremely flexible and adaptable verse form in his hands. With seemingly no effort he could accommodate it to the varied requirements of straight narration, character portrayal, description, or reported dialogue. The rhythm is elastic, and he pulls or compresses or twists it in order to convey oral speech patterns. Throughout, representation of the spoken word is a basic concern of his technique. He makes frequent use of pauses for dramatic effect. It may be said in a general way that Brown was more interested in the matter itself than in following any given set of rules. In "Mary Quayle" he changed to a combination of "pseudo-dochmiacs" and heroic couplets. In "Bella Gorry" he gave a good account of his ability to handle blank verse.

If any single adjective can summarize the total effect of these narratives, that word is healthy. They have the freshness of a cool salt breeze. There is no trace of morbidity, no fevered search for the unknowable, no agonized self-pity. That fin de siècle weariness of body and spirit which gives to the work of so many of his

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contemporaries its characteristic note is almost wholly absent. In its place we find an abiding belief that life is good, that humanity is deserving of our faith, that God can be trusted. Brown took his characters as they came, none wholly good nor wholly bad, and so he presents them to others. His boyish appreciation of fun, his healthy good spirits, maintained to the end his keen taste for the unending comedy of life.

The narratives classify him as a dialect poet, a local-color poet, and a realist. Their effect is cumulative, building up page by page like a mosaic. Sometimes our credulity is strained by Baynes's omniscience, or by an overworking of coincidence in the resolution of the plot. He was not always able to pull himself free from the stultifying demands of convention -- any woman who loses her lover is summarily condemned to die of a broken heart. Yet despite all the pathos and sentiment, no evaluation of these yarns can ignore the extent to which they are colored by Brown's sense of humor. Sometimes it is broad farce, but more often it is an inward smile, a twinkle in the eye. Much of it is "situation comedy," provoking laughter by virtue of certain relationships and personalities and situations built up over a period of time. His best humor is based upon a mental picture, liberally embellished with exaggeration, and ending with a dry "punch line" delivered with mock-seriousness.

Brown's stories often treat of subjects generally considered daring at the time he wrote--seduction, betrayal, drunkenness, prostitution. He even ventured upon such ticklish subjects as frigidity, abnormal desire, and homosexuality in women. It is not too much to say that sexual love, in some form or another, enters into almost every story. There is no prudery or false modesty in his treatment of it, but there is also no sensationalism or licentiousness. His attitude throughout is frank, open, and healthy. There are no fleurs du mal in Brown's garden.

To Manxmen especially, and to many non-Manxmen, these yarns of the fo'c's'le are and will remain his greatest work, and his surest claim to literary fame. They are so dominated by the personality and spirit of Brown and his alter ego Tom Baynes that I can think of no fitter motto for them than Whitman's words in "So Long":

> Camerado, this is no book;
> Who touches this touches a man.

Admitting the many virtues of the narratives, and realizing full well that no just estimate of his position can fail to consider them, I must nevertheless conclude that his future reputation will be based primarily upon the lyrics. Moving from the yarns to the lyrics is like turning from one poet to another. We might liken the change to that experienced by the reader turning from Lowell's Biglow Papers to Hopkins' "Windhover." In these lyrics we have the expression of an entirely different facet of Brown's many-sided personality; the voice of the poet transcending the voice of the Manxman. Most of his lyrics were first published in Old John and Other Poems in 1893. Others appeared in various periodicals.

The poet of Fo'c's'le Yarns and the Manx dramatic monologues was an objective poet; the author of the lyrics was subjective. The lyric impulse reached beyond the transitory and the material toward the eternal and immaterial, creating a poetry that was at once more personal and more universal. He claimed no special message for his time, and was apart from the principal literary currents of his generation. His poems are the result of long rambles and solitary musings. They are permeated with sympathy for man, love for nature, and a spiritual struggle to achieve a complete faith. With a freshness and sparkle which is a constant surprise, Brown ranges over a wide variety of subjects and moods. There is depth and fervor in the religious poems, mystic exaltation, subtle phrasing. There is bold speculation, exquisite nature description, and penetrating observation of character. Allowing for a degree of overlapping, his lyrics may be classified by subject matter into these principal groups: Character Studies, Aspects of Nature, Social Relationships, Elegy and Epitaph, Literature and Art, and Philosophy and Religion. The last group is considerably larger, and more significant, than the others.

The most brilliant of the character sketches is "Roman Women"--a vivid, original, and vigorous example of youthful enthusiasm and passion by a poet old in years, but young in heart. The nature verses display both his practical knowledge and his intuitive perceptions of nature and natural objects. His landscapes are frequently fine. His descriptions of streams, birds, flowers, and other natural phenomena are marked by sensitive charm, delicate imagery, and often by a Puckish humor. Personification is a constantly employed device in these, and nature served him as an endless source of imagery. Brown's theories of both nature and art were influenced by, and in a sense a part of, his religious faith. Nature, properly understood, is the great source and inspiration of art; art, properly understood, is the interpreter and reflection of nature and human nature. His elegies and memorial verses are unlikely to win him any new devotees. Their brilliancies are separated by too many pedestrian passages and conventional sentiments. With the exception of "Aber Stations" and "Clevedon Verses," they can best be described as "adequate."

His finest work is in the philosophical, religious, and mystical lyrics. To read them appreciatively, the reader must understand that Brown was a natural mystic, a pantheist, who came into closer and more vital contact with God's infinite manifestations in nature than in creeds or churches. He did not engage in theological controversy: his disputes went directly to the source. The lyrics embody frequent questionings, protests against the apathy or apparent cruelty of nature. When he receives no reply, he does not hesitate to attack; many of the poems are bristling with reproach. He has a robust and familiar way with things divine that distinguishes his work from that of other natural mystics such as Wordsworth. The divinity he knows is an Immanent Presence in nature, creative and vigorous, not static but developing, not logical but loving, not omniscient but omnipresent. Many of these lyrics express his desire for union with this spirit, of his pursuit of the so-called Mystic Quest. With this mysticism he combines a vigorous realism of expression and choice of subject. His bold and familiar treatment of spiritual matters, his refusal to gloss over the ugly or unpleasant aspects of experience, his mixture of visionary and intuitive perception with enlightened common sense--these qualities suggest for Brown the seemingly self-contradictory label of "realistic mystic."

There are in his work suggestions of a large number of poets, notably Wordsworth, Swinburne, Browning, Arnold, Whitman, Crabbe, Edward Taylor, Father Tabb, and John Donne. Yet while suggesting so many diverse poetic voices, he has not submerged or distorted his own.

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It is often a strong voice, frequently thrilling, always honest. In reading his lyrics as a whole, one is perhaps most struck by the amazing variety of moods, of subjects, of verse forms, of meters and rhythms. The common denominator is emotion: emotion in a thousand forms and disguises, but always warm, and always human. His work has not been weighed and found wanting; it has simply been neglected. It is to be hoped that the recent reprinting of his poems and letters may lead to a resurgence of interest in his work, and eventually bring to an end the neglect which has surrounded it for too long.

353 pages. $4.55. Mic 58-4832

Abstract published by special arrangement with The Ohio State University.

JEROME AND JEAN THARAUD: A STUDY IN MODERN FRENCH ROMANTICISM

(L. C. Card No. Mic 58-1437)

Paul Arthur Moylan, Ph.D.
University of Michigan, 1957

The purpose of this study is to analyze and evaluate the works of Jérôme and Jean Tharaud in an effort to determine their place in the history of modern French literature.

Literary critics of their own generation and those of later generations have for some reason neglected Jérôme and Jean Tharaud. No one has made a definitive study of their published works, and the critics who have said anything at all about the Tharaud brothers have for the most part made only general statements about the characteristics and the artistic value of their writings, with no more than sporadic references to individual works. In the absence of abundant critical estimates of these writers, it has been necessary, for the purpose of the present study, to rely principally upon what the Tharauds have said themselves about their literary and aesthetic convictions and their ideas about literary creation.

Jérôme (1874-1953) and Jean (1877-1952) Tharaud belong to the literary generation which came to maturity around 1895. A Goncourt award in 1906 established their reputation as professional writers. They were elected to the French Academy, Jérôme in 1939 and Jean in 1946. Although they continued writing until shortly before their deaths, the Tharauds remained somehow fixed in that period of national rediscovery in the final years of the nineteenth century, a period dominated by the youthful idealism of Charles Péguy and Maurice Barrès. The Tharauds acknowledged Barrès as their "friend and master", after serving him as secretaries for about fifteen years.

The Tharaud brothers collaborated on everything they wrote. The nature of their collaboration they declared to be as mysterious to themselves as it was to everyone else. Two minds were at all times indispensable to the creation of one book, since one brother was helpless in the absence of the other.

Exoticism is the keynote of the writing of Jérôme and Jean Tharaud. Their works, which reflect their extensive travels and their many-sided interests, are more reportorial than fictional. They show the tendency of these writers to find meaning in the fragmentary moment and to reject, in the fashion of romantic dreamers, the discipline of mature decision. At the same time, the impressions and ideas which the Tharauds synthesized from the constant exchange afforded by their collaboration served a fundamentally didactic purpose. Their propensity for universalizing their experiences came from a sound classical training which influenced their writing and thinking even when they were thoroughly swayed by fancy. Disturbed by the materialism of a world which they found increasingly turbulent, the Tharauds retreated into an egocentered, antirational life of contemplation. They found security in the "truth of the dream" and in the identification of the individual with the larger totality of the national heritage, in a manner that was as romantic as it was inconclusive.

Because of their attachment to fugitive impressions, Jerome and Jean Tharaud constantly looked for mysterious sights. Mystery satisfied their inveterately romantic taste for a type of self-centered revery, directed towards things that, however inconsequential, appealed to their fancy.

Worshipers of tradition, the Tharaud brothers avoided controversy. They discussed such matters as the ethics of imperialism, the political and social role of the Jew in modern Europe, and the genesis of religious fanaticism, but they did not conclude. They left these matters unresolved apparently because they could not satiate their thirst for beauty and mystery long enough to be decisive themselves. They preferred to idealize the past in an ideology based upon narrow nationalism, an oversimplification of the problems of history, and a penchant for persons and places combining reality and illusion. In the history of modern French literature Jérôme and Jean Tharaud are latter day romanticists, who found their moral absolute in the security of a perpetual dream.

190 pages. $2.50.

AFIRMACIONES DE LOPE DE VEGA SOBRE PRECEPTIVA DRAMÁTICA A BASE DE CIEN COMEDIAS

(L. C. Card No Mic 58-1449)

Louis Celestino Perez, Ph.D.
University of Michigan, 1957

There are two parts to this thesis. In the first part an attempt is made to give a synthesis or resumé of the prominent criticism which has established several schools of thought concerning Lope de Vega's dramatic work as an artist. After studying this criticism one finds that it is next to impossible to extract precepts with which all these different critics agree. The conclusions, based on this collection of statements, may be several and are dependent entirely on the leanings or tendencies of the reader.

The second part studies closely the dramatic ideas and literary beliefs expressed by Lope in a certain number of his works (poems, essays, plays and prologues to the plays) with the intention of discovering precepts that this dramatist might possibly have pursued. This was the intent, regardless of the fact that some critics had insinuated long ago that his art was one of hit or miss, governed by his fancy at the time of writing.

It was found that he expressed definite ideas on precepts which should govern the writing of a play, and that it seems that he followed these precepts when not in direct conflict with his idea of verisimilitude.

We can also conclude that his precepts were not, in many respects, very different from those of the mainstays of classical dramatic theory - Aristotle and Horace. He kept in mind these precepts and discovered others suitable to his times. His precepts, in which he firmly believed if we are to judge from the repetitious and emphatic manner in which he states them, were simple:

1. That a good play should entertain. This was perhaps of the utmost importance to Lope.
2. That it also include a lesson or moral. In Lope, the entire play is usually one great lesson, with secondary ones sown throughout.
3. That to bring about these goals (to entertain and to teach) the poet was to imitate nature, the old classics, and the great writers of the peninsula; to follow (very emphatically) the principle of verisimilitude; to adapt to literature the techniques of painting.

He conceived his theatrical pieces as large canvases. The play (with its adornment, contrasts, variety, etc.) was to be seen as one complete and indivisible work, with its component parts so well woven together that it left no hanging threads but an artful finished tapestry.

262 pages. $3.40.

THE IMMIGRANT AND OTHER FOREIGN CHARACTERS IN THE BRAZILIAN NOVEL

(L. C. Card No. Mic 58-1360)

Herman Bernard Slutzkin, Ph.D.
Columbia University, 1957

Immigrant adaptation is the theme of a large number of novels, and in these and many others a host of foreign characters are introduced. Besides documenting Brazilian life, they contribute to an appreciation of each author. Immigrant characters run the economic range from peddler to potentate; they range spiritually from the repulsive or sinister to those marked by humaneness or idealism. Characterization is influenced by the political or social philosophy of the author, by his esthetic allegiance or tendency, or by social realities. In general, the immigrant does not fare badly in comparison with the old-line Brazilian.

"Colorful" immigrant or foreign characters are widely used. Foreign clergy predominate; there are a few more or less extended portraits of American pastors and educators. Prostitutes, represented in nearly all authors, are almost uniformly of foreign origin, largely French but including numbers from Spain, Italy and Poland. The generic terms are francesa and polaca. Their presence is customarily recorded without condemnation or evaluation, although social implications may be gleaned in Lima Barreto or Jorge Amado.

Hostility toward the newcomer, evidenced in the novels, is motivated by patriotism and economic rivalry. Resentment is shown toward German resistance to integration, Italian and German nationalist activity and "economic imperialism" through English and American capitalists and speculators. The rise of Italian, Portuguese or Levantive elements contrasts sharply with the retrogression or lack of progress of native Brazilians. Nevertheless, the positive characteristics of the immigrant groups are widely appreciated, and those authors prophetic in spirit are optimistic of final assimilation.

The Portuguese suffer both from traditional antipathies and economic jealousy. The composite immigrant, who rises "from rags to riches," has great physical strength, perseverance, commercial acumen, passion for wealth and lack of scruple. He has a weakness for mulatto women. Italians, on the other hand, are generally popular. Warm and picturesque people who assimilate readily, they tend to be florid in complexion and speech, emotional, volatile and voluble. Spaniards are most frequently colorful anarchists or passionate ladies of easy virtue. Practically all Frenchwomen are prostitutes. Germans are blond or blue eyed; clean, neat, orderly, efficient and progressive; either "cold" or gemütlich, race-conscious and hard to assimilate.

English, fair-haired and blue-eyed, and Americans are imperialists, exploiters and corrupters. Russians tend to nihilism. Syrians and Lebanese (turcos) are shade peddlers and merchants. Anti-Semitism is voiced by various characters and two authors: Salgado and Graça Aranha.

Literary Values. Manoel Antônio de Almeida's Portuguese live through his precocious realism, whereas the English, Spanish or Jewish characters of Alencar remain melodramatic Romantic figures or comic stereotypes: in the latter category is the German naturalist of Taunay's Inocência. Machado de Assis has no major foreign characters. Mrs. Oswald, with stock English characteristics, belongs to his early, atypical period; Marcela, the Spanish cocotte, is a striking evocation of the predatory female.

Aluízio de Azevedo, abounding in immigrant characters, is most successful in creating the ethnically-mixed milieu, e.g. tenement life in Rio. Characterization suffers from naturalistic preconceptions and personal bias. Pompeia's Angela is a patently false portrait of a lubricious Spanish servant. Graça Aranha's major characters, like those of Salgado and, to a degree, those of Vianna Moog, remain abstractions. Lima Barreto has psychological insight; Vincente and Olga Coleoni are excellently realized. Fräulein (Mário de Andrade) provides a vehicle for satire. Partisan social analysis dominates individual psychology in Jorge Amado, while Veríssimo is free of ideological limitations. Carneiros's Syrian characters are effectively drawn. Swedish Edna of Lins do Rego's Riacho Doce is weakly Freudian. Batini's interesting Italian and Portuguese protagonists are not always convincing.

Some of these characters are superior creations. None attains genuine universality. 348 pages. $4.45.

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AMERICA IS NOT NORWAY: THE STORY OF THE NORWEGIAN-AMERICAN NOVEL

(L. C. Card No. Mic 58-1365)

Gerald Howard Thorson, Ph.D.
Columbia University, 1957

Although the Norwegian-American novel has assumed characteristics of both Norwegian and American literature, its development stands as a distinct literary movement, growing out of the cultural and social consciousness of an immigrant group seeking its own identity in a foreign land. For this reason, although literary influences and critical standards are not neglected, "America Is Not Norway," in tracing the growth of the novel from its beginnings in 1874, emphasizes the relation of the novel to the life of the immigrant. The study is, therefore, cultural rather than purely aesthetic.

After an introductory chapter sketching the background of the Norwegian-American community, five chapters reconstruct the history of the novel chronologically, focusing upon the major writers: Kristofer Janson, Drude Janson, Hans Foss, Peer Strømme, Ole Buslett, Simon Johnson, Waldemar Ager, Ole Rølvaag, Johannes Wist, and Jon Norstog. Not professional writers, these men were, at best, casual literary artists. A final chapter attempts to summarize and analyze the novel as a literary and cultural movement.

Written primarily for Norwegian Americans, the novels have dealt specifically with immigrant life and problems, chiefly in the Midwest. Prevalent issues have been religious disputes, political differences, and temperance, but the dominant theme has been the assimilation of the immigrant into the American stream of life, with most novelists opposing a rapid Americanization, proffering instead a retention of Norwegian culture in America. Thus the novel has been not only an aspect of culture, but an instrument of culture, a force that has aided Norwegians in making the transition to a new life while at the same time preserving their group's identity.

Especially interesting are the changing attitudes revealed toward Norway and America. Early criticism of Norway dealt primarily with class distinctions and the lack of economic opportunity for the peasant. There was no wholesale repudiation of the fatherland. As the years passed, the collapse of the "American dream" was accompanied by a nostalgic longing for the Old World, and the novelists became increasingly active in conscious attempts to preserve cultural and national ties.

Norwegian-American novelists have been critical of American life, especially the emphasis upon materialistic values. Yet the criticisms leveled at America have stemmed from a desire to preserve the cultural and national ties rather than from the disenchantment which came from unrealized dreams. The basis of the Norwegian-American novelist's complaint of America, therefore, has not been the delay in America's assimilation of the immigrant but the rapidity with which the immigrant himself sought to adopt the mores of the native Americans. Thus the novelist reserved his most pointed criticism for the immigrant himself.

Unlike much of American frontier literature, the Norwegian-American novel was the product of men who lived in the midst of the experiences of which they wrote. The characters of their novels, on the whole realistically treated, were not supermen, but ordinary pioneers, frequently depicted as failures, lonely aliens tragically displaced in a strange land.

Revealing the importance of the "foreign" heritage in the shaping of the American character, the Norwegian-American novel shows that men on the frontier were not simply products of sociological and geographical conditions: they were first and foremost products of Old World habits and traditions. Their basic struggle was not against nature and environment, but the continual interplay of old and new values in a world of change. Aware of the dilemma which this posed, the Norwegian-American novelist sought to help the immigrant to fulfill the promises expected of him in the building of the new nation. 480 pages. $6.10.

ARGENTINA AS SEEN BY BRITISH TRAVELERS: 1810-1860

(L. C. Card No Mic 58-1008)

Samuel Santo Trifilo, Ph.D.
University of Michigan, 1957

British interest in the region of the River Plate developed relatively early, but, due to Spain's monopolistic trade policy with regard to her American possessions, few Englishmen had the opportunity to visit that area during the colonial period. However, after 1810, with the independence of Argentina, and the lifting of the trade barriers, countless Englishmen sailed to the port of Buenos Aires, with adventure and profit in mind. Many of these travelers kept diaries and journals which were published in book form after their return to England.

The purpose of this study is twofold: first, to present a synthesis of the impressions received by the British travelers in Argentina, during the years 1810-1860, as extracted from the many books of travel written during that period; and second, to evaluate this travel literature, both from this investigator's point of view, as well as that of a number of contemporary Argentine critics.

This investigation is the result of the collection, evaluation, and integration of observations concerning Argentina, by many British travelers in that country, during the years 1810-1860. In the first chapter, an attempt is made to trace briefly the beginnings of British interest in South America, particularly Argentina, up to the year 1810. In the second chapter are discussed the growth and development of this interest during the years 1810-1860. The next six chapters deal with Argentina as it was seen and described by British travelers. The principal places discussed are: Buenos Aires; the Pampas; Mendoza and the Andes; the Upper Provinces; the Paraná Provinces; and the regions of Patagonia and Tierra del Fuego. The ninth chapter discusses the reasons why this British travel literature has, of late, attracted Argentine readers, while the last chapter presents a critical evaluation by this investigator of the best works studied.

A number of interesting and revealing conclusions can be drawn from this study. The most important is that these British travelers left for posterity a precious source of documentary information dealing with the Argentina of the first half of the nineteenth century. Generally, the British travelers attempted to be objective and fair in

their judgment of the country and the people. As a result, we have available an undistorted, unbiased, authentic description of that country. These travel accounts are invaluable for the information they contain concerning the social, political, cultural, and economic aspects of Argentina during the period under discussion. Through these books, the modern researcher is able to obtain authoritative information regarding the country, the people, their manners and customs, their institutions, their methods of travel, etc.

This travel literature has stimulated interest among a number of contemporary Argentine and Uruguayan critics. Men such as Enrique Espinoza, Ezequiel Martínez Estrada, Carlos Aldao, José Luis Busaniche, and Carlos Real de Azúa, have found in these English travel books an unprejudiced, impartial picture of the Argentina of 1810-1860. They claim, that, unlike native writers, who tended to be biased and prejudiced, one way or another, the British travelers, as a rule, tried to be objective and truthful in recording their impressions of the country and the people.

395 pages. $5.05.

LIBRARY SCIENCE

RAYMOND CAZALLIS DAVIS AND THE UNIVERSITY OF MICHIGAN GENERAL LIBRARY, 1877-1905

(L. C. Card No. Mic 58-1370)

John Cushman Abbott, Ph.D.
University of Michigan, 1957

The purpose of this study is to provide a detailed description of the University of Michigan General Library during the administration of Raymond Cazallis Davis, from 1877 to 1905, and to supply such biographical material relating to Davis as will explain his role as Librarian.

Part I of this study is comprised of a biography of Davis, from his birth in a Maine seacoast town in 1836 to his death in Ann Arbor in 1919. His early education was obtained in the local district schools which he attended until the age of thirteen. Then came two years spent in a world voyage and four years in academies in New Hampshire. He entered the University of Michigan in 1857, but as a result of a nervous breakdown near the end of his second year he was forced to give up serious intellectual labor for ten years. By 1868 he had recovered sufficiently to permit him to accept the position of Assistant Librarian of the University of Michigan, a post which he filled with much success. In 1872 he was unexpectedly appointed to succeed the incumbent Librarian, Andrew Ten Brook. However, Ten Brook received considerable support from the faculty and was allowed to continue in his post, with the result that Davis returned to Maine without an occupation. In 1877 Ten Brook was deposed without apparent opposition and Davis, then forty-one, became Librarian.

Part II is comprised of a history of the University Library under Davis. The most important single event of Davis' administration was the construction of the 1883 Library building, the most notable features of which were the multitier book stacks and the provision of seminar rooms. The chief problem faced by Davis was the necessity of building up the book collections in order to provide adequately for the instructional and research needs of the University. While the collections did not increase as rapidly as did those of most of the major universities, the collections did increase eight times from the approximately 24,000 volumes in 1877, a considerable achievement in view of the funds available. Unfortunately, some aspects of the Library's services were in some degree slighted due to the limited resources available and the demands made by the basic functions of acquisition and organization of the collections. Davis' interest in the public service aspects of librarianship is illustrated by his introduction, in 1883, of a credit course in bibliography, the first such course offered in this country. Since the book collections were accessible to only a small proportion of the users, much emphasis was placed upon improving the card catalogs, which were divided into author and subject sections, the latter including periodical articles and other analytics. The fixed location classification which Davis devised in 1883 presented major difficulties and in 1897 the reclassification according to the Dewey system was begun. A major innovation was the assigning of most literary works, regardless of form, and works pertaining to them, of American and British authors, to Dewey 828, or equivalent numbers for other literatures. Also the Dewey 400's, philology, were eliminated, and combined with the 800's, literature. 315 pages. $4.05.

CONFEDERATE JUVENILE IMPRINTS: CHILDREN'S BOOKS AND PERIODICALS PUBLISHED IN THE CONFEDERATE STATES OF AMERICA, 1861-1865

(L. C. Card No. Mic 58-1025)

Sarah Law Kennerly, Ph.D.
University of Michigan, 1957

This two-part study attempts to discover and to analyze the children's books and periodicals published in the Confederate States of America, 1861-1865. The first part--a narrative survey--describes the publications and quotes from them in enough detail to give a comprehensive picture of this small segment of nineteenth-century children's literature. The second part--a classified, annotated bibliography--lists every Confederate juvenile imprint known to the compiler and locates extant titles.

Although the precise number of Confederate juveniles published cannot now be accurately determined, a count which considers every different edition of a book as a separate publication indicates that at least one hundred fifty books and six periodicals were published. These

war-time products were found to fall into four categories: textbooks, religious books, recreational books, and juvenile periodicals. A quantitative analysis shows that over seventy per cent of the Confederate juveniles were textbooks for primary and intermediate grades. Primers, spellers, and readers made up two-thirds of the textbooks and half of the entire list of juvenile imprints. For the Sunday schools, which flourished in the small-town and rural South, about thirty paper-backed catechisms and little Sabbath school hymn books were published, some of them original works and some reprints of earlier pamphlets impossible to obtain in the Confederacy. Four of the six known juvenile periodicals were Sunday school papers: one was Baptist, one Presbyterian, one Methodist, and one (the shortest-lived) nondenominational in tone. The Confederates showed comparatively little interest in recreational reading for children. Only ten or twelve books and two periodicals were ostensibly for entertainment, and most of them contained much didactic and religious material.

Qualitatively the Confederate publications were found to be generally mediocre in style and sentimental or moralizing in tone--typical products of the mid-nineteenth century. A few were characterized by extreme chauvinism, but the majority were very similar to Northern publications. Some of the textbooks, for example, were newly written by Confederate authors, but many were revisions, or even reprints, of older Northern textbooks previously used in the South. No children's literature of any lasting value was produced in the Confederacy; reading matter breathed an air of didacticism and piety that stifled the imagination. If the Confederate juveniles are considered in a sociological, rather than a literary, light, however, they show the South's stern attitude toward the intellectual, moral, and religious training of children, and rectify some of the romanticized concepts of life in the Confederacy.

The format of the Confederate juveniles verifies the fact that they were emergency products, published by people without proper training or equipment, in a country plagued by shortages of all sorts. The rough and unbleached paper, the strange assortment of type faces, the poor ink, the inappropriate woodcuts, the wallpaper covers--all are pathetic makeshifts; yet, ironically, they give to Confederate juveniles a quaintness and individuality that have helped make them collectors' items.

In the final chapter of the survey, a representative group of extant books and periodicals judged most noteworthy in content or format has been selected for the benefit of persons interested in a firsthand study of Confederate juvenile imprints. 495 pages. $6.30.

THE SCHOOL LIBRARY'S CONTRIBUTION TO THE TOTAL EDUCATIONAL PROGRAM OF THE SCHOOL: A CONTENT ANALYSIS OF SELECTED PERIODICALS IN THE FIELD OF EDUCATION

(L. C. Card No. Mic 58-1431)

Edna Ballard Mack, Ph.D.
University of Michigan, 1957

The object of this study is to analyze the content of representative education periodicals thought to be most generally available and of considerable potential interest to elementary and secondary school administrators, for the purpose of determining the nature and amount of the school library information contained therein, especially that pertaining to the school library's contribution to the total educational program of the school. The importance of this particular information being made available to the administrator arises from his responsibility for the school library as an integral part of the total school program, and from his reputed reliance upon professional periodicals as a principal cource of information about contemporary practices and trends in his field.

In surveying the entire content of 13 selected periodicals published from September 1, 1954, through August 31, 1955, it was found that only 11 of the 1561 articles deal specifically with school library matters, but that 225 other articles and 38 other parts of the periodicals also contain school library items.

Examination of all the assembled items of school library information showed that in the area of the instructional program the greatest amount of attention is given to the library's contribution to Language Arts instruction, considerably less to its participation in Science, Social Science, Special Education, Citizenship Education, and "core" programs, and almost none to its potential in other areas of the curriculum or in extra-curricular activities. In the area of special services and agencies, the library's relationship to audio-visual, guidance, and public library programs and services is emphasized. In the area of administrative arrangements for school library service, the provision of adequate materials and quarters is amply documented, but the cooperative selection of materials is mentioned less frequently. There is little or no information about the librarian as administrator, the training and recruitment of school librarians, or the provision of supervisory or consultant services. Insofar as comparison was possible, a large majority of the items of school library information were found to compare favorably with nationally accepted school library standards.

A number of conclusions may be drawn from the study: (1) it seems advantageous that the information presented in articles specifically on the school library is supplemented appreciably by school library items in other parts of the selected periodicals; (2) school librarians have assumed little responsibility for contributing to the dissemination of school library information by writing for these periodicals; (3) the scant attention to the school library's contribution to a number of curriculum areas and to co-curricular activities is inconsistent with the modern concept of the library as a teaching and service agency for the entire school; (4) information about the library's relationship to other special services and agencies is uneven in emphasis and inadequate in coverage; (5) information about administrative provisions for school library service, with the exception of those for library quarters, is limited in amount and scope; and (6) the school library information presented is generally in agreement with national school library standards, although the information regarding administrative provisions for school library service appears to be most inadequate. Finally, while the administrator may find a certain amount of information about specific ways in which the school library program may be integrated with the school program, he will not find in these periodicals adequate information about administrative provisions for school library service.

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Implied throughout is the need for librarians, school administrators, and editors to cooperate in making available in education periodicals the kinds and amounts of information that would be of most help to readers, and especially to administrators, in understanding the school library's actual and potential contribution to the total educational program of the school. 389 pages. $5.00.

THE PAPERBOUND BOOK IN AMERICA: THE HISTORY OF PAPERBACKS AND THEIR EUROPEAN ANTECEDENTS

(L. C. Card No. Mic 58-984)

Frank Leopold Schick, Ph.D.
University of Michigan, 1957

It is the purpose of this study to describe the history of paperbound books published in America from the beginning of printing to 1955, to indicate the foreign influences which provided significant directions, and to explain the growth of a branch of the publishing industry which has found over 100,000 outlets for its products on the North American continent.

The topic was chosen because it was felt that a format which permits the simultaneous release of average editions of 150,000 to 200,000 copies has far-reaching effects on the reading habits of the population. Writers and researchers in the field have paid scant attention to the background of this development because they have concentrated primarily on the beautifully bound and illustrated book or on the contents of publications. One can easily gain the impression that inexpensive paperbound books appeared rather suddenly on the American scene and had their beginnings in the nineteenth century. Examination of early American almanacs, sermons, tracts, and chapbooks indicates that inexpensive original and reprint publications in paperbound format have been produced in considerable quantity since the first days of colonial printing. While production techniques changed and the contents of the books were adapted to the varying demands of the times, the basic appearance of these publications has remained surprisingly similar over three hundred years.

The study is presented in two sections. Part I is an account of the history of paperbacks in Europe and America from the incunabula period to the 1930's. Examination of early publication specimens found among the holdings of the New York Public Library and Columbia University, and a survey of the available literature provided the data for this part. Part II presents a picture of the current phase of the paperback development from 1939 to 1955. Information was obtained through personal interviews and correspondence with the executive personnel of paperback publishers, and examination of promotional materials provided by them. A total of forty-three firms was covered. The interviews were arranged through the cooperation of the American Book Publishers Council and took place in April, 1954, and between September of the same year and May, 1955.

Two approaches were used to present a clear picture of the current performance of the paperback industry. (1) The histories of the individual firms and a survey of their literary productions were presented and grouped under the following headings: Exclusive Paperback Publishers, Paperback Lines of Magazine and Pulp Publishers, Paperback Lines of Regular Trade Publishers, Scholarly Paperbacks, and Religious Paperbacks. (2) A chronological picture of the year by year progress of the entire industry was given, and separate sections were devoted to problems of technical production, literary output, the relationship between authors and publishers, censorship, and patterns of distribution.

The study led to the conclusion that the history of American paperbacks is not merely the account of a technical revolution, but an unfolding of cultural significance. Improvements in production techniques and modern methods of promotion and distribution have brought book ownership within the reach of every American. Outside the United States, paperbacks are the only books foreign countries can afford to buy in quantity. Consequently, they are an important factor in the evaluation of our cultural and literary standards abroad. Paperbacks may soon change our established methods of publishing and have started to influence the acquisition policies of our libraries. Since culturally valuable titles are finding a growing market, paperbacks are doing their share to provide educational and recreational facilities in the best tradition of the mass media. While their format makes them impermanent, some of the thoughts they convey may outlast them for generations to come. 344 pages. $4.40.

LEGAL AND GOVERNMENTAL ASPECTS OF PUBLIC LIBRARY DEVELOPMENT IN INDIANA, 1816-1953

(Publication No. 24,840)

La Vern Arlene Doubt Walther, Ed.D.
Indiana University, 1957

Chairman: Haynes McMullen

This study of the legal and governmental aspects of the development of public libraries in Indiana is divided into four main sections. The first is a brief history of the Indiana State Library, the second deals with the legislative development of public library services in Indiana, the third is a comparison of public library service in Indiana and the United States in 1945 and 1950, and the final section mentions the related background factors (geographic, social, educational, economic and historical) that have brought about the development of public library services in Indiana.

Summary

The State Library was established in 1825 to serve state officials. In 1903 the services of the State Library were extended to the citizens of the state and to the public libraries of the state. The Public Library Commission was established by law in 1899 and functioned until 1925 when it was absorbed by the State Library. During the twenty-six years it was instrumental in organizing 156 city or town libraries.

County libraries were provided for in the Constitution of 1816. These libraries did not receive sufficient support

and no arrangement was made for extension of services to citizens living outside of the county seat. However, these libraries furnished the chief materials to which the Indiana public had access during the first part of the nineteenth century.

A law was passed in 1852 which permitted the organization of township libraries. The services of these libraries began with identical library collections purchased by the State Board of Education for the townships, but no permanent support was legislated. By 1919 the law for township libraries had been amended so that each library selected its own books and could raise a levy of one mill on the dollar for library purposes.

The development of libraries in cities and towns has been a part of the State legislative picture since 1816. A law was passed in that year allowing citizens of a city or town to incorporate a library if one hundred dollars was subscribed by private citizens. Libraries were supported mainly from private source until 1881 when a law was passed which permitted the establishment and support of a library entirely from public funds. From 1881 until 1947, most of the Indiana library laws passed were acts permitting the cities and towns in specific population groups to establish public libraries. In 1947 a general library law was enacted covering all sizes of cities and towns, counties and townships.

Statistically, Indiana libraries compare favorably with those of the United States as a whole. For the fiscal year ending in 1950, Indiana had 68 per cent more volumes per capita and 1.76 per cent more circulation per capita. In Indiana, thirty cents more was spent per capita for the population served than was spent for the libraries of the United States as a whole.

Library service in the rural areas of Indiana has been difficult to organize and maintain because of the many wooded hills, limestone quarries, and state parks and forests. The population shift from the large cities to the fringe areas, together with the changes in the business sections of these cities, has created a serious problem for the public libraries. Statistically, the educational situation in Indiana compares favorably with that of the United States except in the educational attainments of adults twenty-five years of age or older. Perhaps the role of the Indiana public libraries should be to emphasize adult education.

A thorough library survey is needed in order to make plans for attacking the two basic problems; service to unserved areas and adequate financial support of existing libraries. 113 pages. $2.00. Mic 58-4833

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HARMONIC, BIHARMONIC, AND RELATED PARTIAL DIFFERENCE EQUATIONS

(L. C. Card No. Mic 58-1107)

Charles McMurray Braden, Ph.D.
University of Minnesota, 1957

Adviser: Fulton Koehler

This thesis considers certain aspects of the behavior of functions satisfying partial difference equations which involve the harmonic or biharmonic or related difference operators. The first two operators, of course, are analogous to the differential operators Δ, and Δ^2, where $\Delta u = \frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2}$.

In the first chapter of this thesis, a lattice-region, D, is defined as a set of points (x,y), where $x = x_0 + mh$, $y = y_0 + nh$, m,n, = 0, $\pm$ 1, $\pm$ 2, $\pm$ 3, . . . , and the mesh-width, h, is positive. The first and second boundaries of D are defined in terms of adjacency to D. Then symbols are established for forward and backward difference quotients: $u_x = \frac{u(x+h,y) - u(x,y)}{h}$, $u_{\bar{x}} = \frac{u(x,y) - u(x-h,y)}{h}$, etc. Thereupon the harmonic and biharmonic operators, R and R^2, are defined by the relations: $Ru = u_{x\bar{x}} + u_{y\bar{y}}$, $R^2u = R[Ru]$. Certain summation identities, analogous to Green's integral identities in the plane, are then developed, and Green's functions corresponding to R and R^2 are introduced.

Chapter II deals with various properties of the harmonic Green's function, but its main result is the deriving of estimates for a "free-space" Green's function, analogous to the fundamental solution of the harmonic differential equation. By means of these estimates, bounds are obtained for the harmonic Green's functions for finite regions.

In Chapter III, using the results in Chapter II, bounds are obtained for the biharmonic Green's functions, in terms of the diameter of region D.

With these bounds estimates are obtained in Chapter IV for the "truncation error" — that is, for the discrepancy between the solutions of the differential equation $\Delta^2 U = 0$ in $\mathcal{R}$, and the difference equation $R^2u = 0$ in D, where D and its first and second boundaries are in $\mathcal{R}$, and where u = U on the first and second boundaries of D.

Estimates are given of $|U - u|$ in the case where U has bounded sixth derivatives in $\mathcal{R}$, and it is seen that $|U - u|$ approaches zero like h^2 as h approaches zero. Estimates are also given, at points in a slightly more restricted region D, in terms of the upperbound for $|U|$ in $\mathcal{R}$, and here again the error approaches zero under certain conditions.

In Chapters V through VII it is shown that if a real, non-trivial function is biharmonic in a lattice-region which consists of a horizontal, semi-infinite strip, and if it is zero above and below the strip, then the values of that function in any row of the strip must oscillate infinitely often in sign as x increases.

This is proved by treating a considerably more general problem. It is shown that if L is any vertically-symmetric, linear partial difference operator with real, constant coefficients, then every real, non-trivial solution of the semi-infinite strip problem involving L will oscillate infinitely often in sign if a certain allied function, $f(r,\theta)$, has some necessary properties. These properties apply, it is then shown, if L is an even power of another operator of the same class. Thus the sign-oscillation of the biharmonic functions follows as a special case.

In this discussion, in Chapter VI, it is necessary to show that every real, non-trivial solution of an ordinary, linear, homogeneous difference equation with real, constant coefficients must oscillate infinitely often in sign if no roots of the characteristic algebraic equation are real.

115 pages. $2.00.

LIE AND ENGEL MODULES AND THEIR RELATION TO BURNSIDE'S PROBLEM

(L. C. Card No. Mic 58-898)

Robert Lloyd Davis, Ph.D.
University of Michigan, 1957

This dissertation studies two separate topics in the theory of Lie rings and Burnside's problem. One is the theory of free Lie rings, including in particular several new results concerning the "Lie character." The other is the subject of Engel modules, which are defined here in a natural generalization of methods previously used in the study of the restricted Burnside problem. The startling fact discovered here concerning Engel modules is the existence of torsion in a number of cases.

Chapter I sets forth the standard approach to Burnside's problem through Lie rings. Chapter II begins with new derivations of some fundamental Lie-ring identities which are used throughout the rest of the paper. The later sections of Chapter II are devoted to replacing the Thrall-Brandt formula for Lie characters by a formula which does not depend on knowledge of the characters of the symmetric group (which are only tabulated for degree not greater than 14). The formula given here permits easy computation in much higher dimensions than the old formula, but only under restriction to 2 generators.

There are two known consequences in the Lie ring associated with a Burnside group of the group identity $w^p = 1$: (1) that the Lie ring have additive order p, and (2) that $[fg^{p-1}] = 0$ hold identically for Lie elements f and g. An Engel module of exponent m over the integers is defined in Chapter III as the quotient E = L/J of the free Lie module by a certain strongly homogeneous ideal J which is essentially generated by all Lie elements of the form $[fg^{m-1}]$. (The exponent m is not assumed to be prime.) The theorems here may be said to show that condition (2) alone goes a long way toward determining that both (1) and (2) hold.

The results of Chapter III are of two kinds. First there are theorems which give detailed statements of the

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structures of particular Engel modules (exponents 3, 4 and 5). Then there is an analysis of the structure of one special kind of submodule in Engel modules of arbitrary exponent. Here number-theoretic arguments show these submodules contain additive groups of order p when the exponent is a prime power, p^r; otherwise these submodules are free. 76 pages. $2.00.

DUALITIES IN GENERALIZED MANIFOLDS AND HIGHER DIMENSIONAL CYCLIC ELEMENT THEORY

(L. C. Card No. Mic 58-916)

John Mitchell Gary, Ph.D.
University of Michigan, 1957

The purpose of this dissertation is to analyze the structure of the homology and cohomology groups of a space by means of (1) a fundamental system of cycles and (2) higher order cyclic element theory. The fundamental system of cycles is used to extend the Poincare and Alexander dualities to non-perfectly normal generalized manifolds. Our homology and cohomology is always taken over a field.

First, a fundamental system of cycles is defined for general Hausdorff spaces. This definition preserves the essential properties of the fundamental system of cycles, as defined by R. L. Wilder, for compact G_δ subsets of an $1c^n$ space. Let M be a Hausdorff space and let $\{\gamma^r_\alpha\}$ be a basis for $H^r(M)$, where $H^r(M)$ is the cohomology space of M taken over a field A. Then, by reference to duality theorems of S. Lefschetz, there exists, for each γ^r_α, a cycle $Z^\alpha_r \in H_r(M)$ such that

$$Z^\alpha_r \cdot \gamma^r_\beta = \begin{cases} 1, & \alpha = \beta \\ 0, & \alpha \neq \beta \end{cases}.$$

The set $\{Z^\alpha_r\}$ is called the fundamental system of cycles for M. A complete uniform structure is placed on $H_r(M)$ such that the space of linear combinations of the set $\{Z^\alpha_r\}$ is dense in $H_r(M)$ relative to the uniform topology. Suppose we have a mapping which assigns to each γ^r_α an element $a_\alpha \in A$, where A is the coefficient field for the homology. By the duality of S. Lefschetz, there exists an element $Z_r \in H_r(M)$ such that $Z_r \cdot \gamma^r_\alpha = a_\alpha$. The infinite sum $\sum_\alpha a_\alpha Z^\alpha_r$ is defined to be this element of $H_r(M)$.

Our main application of the fundamental system of cycles is in the proof of the Alexander and Poincare dualities for non-perfectly normal generalized manifolds. A second application shows the representation of $H^r(M)$ as a weak direct sum of spaces $H^r(M_\rho)$ induces a representation of $H_r(M)$ as the strong direct product of the spaces $H_r(M_\rho)$ (each M_ρ is a closed subset of M).

The second part of this dissertation extends the higher order cyclic element theory of Whyburn to compact Hausdorff spaces. Whyburn's theory is restricted to compact subsets of Euclidean n-space. The main result shows that if E is any closed subset of a compact space M, where E contains all the (r-1)-dimensional cyclic elements of M, then the mapping of $H_r(E)$ into $H_r(M)$, induced by inclusion, is an isomorphism onto. Also, if $E^1_{r-1}, \ldots, E_{r-1}$ are (r-1)-dimensional cyclic elements of M, then the inclusion mappings of $H_r(E^i_{r-1})$ into $H_r(M)$ induce an isomorphism of $\prod^n H_r(E^i_{r-1})$ into $H_r(M)$. Some other relations between homology and cyclic elements are discussed.

Whyburn has shown that 0-dimensional cyclic elements have special properties in locally connected spaces. We will show that some of these properties do not generalize to higher dimensional cyclic elements. For example, if M is compact and locally connected, and f is a monotone mapping of M onto N, then for every 0-dimensional cyclic element E^N_0 in N there exists a 0-dimensional cyclic element E^M_0 in M such that $f(E^M_0) > E^N_0$. Also, the 0-dimensional cyclic elements of M form a null sequence. These results are not true in higher dimensions.

74 pages. $2.00.

THE DEVELOPMENT OF THE GEOMETRY OF THE FIXED-COMPASS WITH ESPECIAL ATTENTION TO THE CONTRIBUTIONS OF GEORG MOHR

(L. C. Card No. Mic 58-1409)

Arthur Edward Hallerberg, Ed.D.
University of Michigan, 1957

The "geometry of the fixed-compass" includes all contributions which pertain to the geometrical constructions performed with a straightedge and a compass whose opening remains unchanged throughout the construction. In this study the development of this geometry is traced by examining all such known contributions, the context in which they were given, and the possible motivations which led to their consideration. Emphasis is placed on the way the history of this topic illustrates the many "contrasts" which are found in mathematics — the contrasts of simple and advanced mathematics, of utility and abstract theory, of approximation and exactness, of conjecture and demonstrative proof, of puzzles and practicality, of possibility and impossibility, of generalization and specialization.

It is found that the Greeks were unaware of the concept of fixed-compass constructions. The first problems solved under this stated restriction were given by Abul Wefa, an Arab of the 10th century; these constructions were primarily for regular polygons, and the fixed opening was equal to the length of the side or to the radius of the circumscribing circle. Since regular polygons were used in ornamentation, architecture, and fortification, fixed-compass constructions for such uses were given into the 17th century. Such constructions are found in the works of Leonardo da Vinci and Albrecht Dürer.

A theoretical interest in what is possible with the fixed-compass developed about 1550 when three different sequences of constructions (using a single arbitrary opening) for the problems of Euclid's Elements were given by Ferrari and Cardano, Benedetti, and Tartaglia. But these constructions were seemingly lost or ignored during the next several centuries, and a number of less important geometers participated in a "period of rediscovery." In this study previously unrecognized contributions of Clavius, Cataldi, Ramus, Bettini, Schwenter, Leurechon, Nottnagel, Georg Mohr, and William Leybourn are discussed for the first time. Especially important is the identification of Georg Mohr, who anticipated Mascheroni in the geometry of the compass alone, as the author of

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Compendium Euclidis Curiosi. This work, published anonymously in 1673 in Dutch, and translated by Joseph Moxon into English in 1677, gives fixed-compass constructions of most of Euclid's problems. Mohr's constructions, independently obtained, are given together with some of the solutions of the other geometers.

The equivalence of fixed-compass and straightedge to movable compass and straightedge has been approached in three ways. Besides the "all of Euclid" method given by the Italians and Mohr, there is the use of the "intersection" criterion (showing that the points of intersection of pertinent lines and circles can always be found) and the "analytic" criterion (based on analytic geometry and a consideration of the fundamental operations which can be performed under the given restrictions).

The Poncelet-Steiner theorem: all constructions possible with movable compass and straightedge can be accomplished with straightedge alone if one fixed circle with its center is given, was established (1822, 1833) by the intersections criterion. The Poncelet-Steiner circle can be obtained with the fixed-compass. The various modifications of this, including the Severi "small arc with center" theorem, often use concepts from projective geometry in their proofs.

In conclusion, suggestions are made for the use of this geometry in the teaching of mathematics: in plane geometry to illustrate the role of postulates; as the basis for "problem studies" in the history of mathematics; to show interrelations of elementary geometry, algebra, analytic geometry, and projective geometry; and as an introduction to other "limited and extended means" for performing geometrical constructions. 269 pages. $3.50.

SOME PROPERTIES OF THE LATTICE OF ALL EQUIVALENCE RELATIONS ON A FINITE SET

(Publication No. 25,454)

Edley Wainright Martin, Jr., Ph.D.
The Ohio State University, 1952

Let S be a set with elements $\underline{a}$, $\underline{b}$, $\underline{c}$, ... A binary relation $\sim$ which holds for certain pairs of elements of $\underline{S}$ is called an equivalence relation if:

i) $\underline{a} \sim \underline{a}$ for all $\underline{a} \in S$;
ii) $\underline{a} \sim \underline{b}$ implies $\underline{b} \sim \underline{a}$;
iii) $\underline{a} \sim \underline{b}$ and $\underline{b} \sim \underline{c}$ implies $\underline{a} \sim \underline{c}$.

It is known[1] that the equivalence relations on S may be partly ordered, that the union and intersection of two equivalence relations may be defined, and that under these definitions the equivalence relations on S form a lattice. If S is finite and has $\underline{n}$ elements, this lattice may be denoted $\underline{L}(\underline{n})$. The purpose of the dissertation is to investigate some of the properties of $\underline{L}(\underline{n})$. The following is a summary of the major results obtained.

A new proof is given of the theorem stating that $\underline{L}(\underline{n})$ is simple. Homomorphisms and direct unions of lattices of equivalence relations are considered, and the results obtained are applied to characterize quotient lattices in $\underline{L}(\underline{n})$. It is shown that any quotient lattice in $\underline{L}(\underline{n})$ is the direct union of $\underline{L}(\underline{n}_1)$, $\underline{L}(\underline{n}_2)$, ... , $\underline{L}(\underline{n}_k)$, where $\underline{n}_1 + \underline{n}_2 + \cdots + \underline{n}_k \leq \underline{n}$.

It is known[2] that every lattice can be represented as a sub-lattice of the lattice of all equivalence relations on some (infinite) set S. However, it is not known whether or not each finite lattice can be represented on a finite set. If any finite lattices require infinite sets, it seems likely that difficulties should arise in representing large lattices that are generated by a small number of elements.

In the dissertation, however, there is given an example of a lattice of arbitrarily large dimension generated by three elements which may be represented as a sublattice of the lattice of all equivalence relations on a finite set.

A portion of this paper is devoted to determining sets of lattice elements which generate $\underline{L}(\underline{n})$. A necessary and sufficient condition is given that a set of lattice points generate $\underline{L}(\underline{n})$. It is also shown that if $\underline{C}$ is the number of possible combinations of $\underline{r}$ objects taken $\underline{s}$ at a time, and if $\underline{n} \leq \underline{C}$, then $\underline{L}(\underline{n})$ may be generated by $\underline{r}$ lattice elements.
62 pages. $2.00. Mic 58-4834

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Abstract published by special arrangement with The Ohio State University.

THE OPERATIONAL CALCULUS OF THE LAGUERRE TRANSFORM

(L. C. Card No. Mic 58-955)

Joseph Courtney McCully, Ph.D.
University of Michigan, 1957

If a kernel function K(s,x) and an interval $a < x < b$ are prescribed, the linear integral transform of an arbitrary function F(x) with respect to that kernel is the function

$$T\{F\} = \int_a^b K(s,x)\, F(x)dx = f(s)$$

of the parameter s. Under many such transformations a class of boundary value problems in differential equations reduces to a simpler class.

It is the purpose of this study to develop the theory of a new form of the operational calculus of a linear integral transform whose kernel is $e^{-x}L_n(x)$, n=0,1,2, $\cdots$, where $L_n(x)$ is the Laguerre polynomial of degree n. The interval considered is $0 < x < \infty$. The transform is called the Laguerre transform. The Laguerre polynomials, $L_n(x)$, form an orthogonal set which is known to possess various other properties. The use of these properties enhances the development of useful operational properties of the Laguerre transform.

It is shown early in the study that if one desires to reduce the differential form

$$L[F(x)] = xF''(x) + (1 - x)F'(x)$$

to a simpler expression the Laguerre transform will arise as a natural consequence of the reduction. The basic operational property for the Laguerre transform also comes out of the above process. The formula

$$T\{L[F(x)]\} = -nf(n) \quad (n = 0,1,2, \cdots)$$

represents the first basic operational property under which the differential operation L [F] is replaced by the algebraic operation -nf(n).

In order to give the operational calculus based on the Laguerre transform a fuller force further operational properties are developed. An inversion process, which depends on the orthogonality property of the Laguerre polynomials, is discussed as well as results on the transformation of certain differential forms. The differential forms considered are those connected with certain differential equations, called Laguerre's differential equations. The Laguerre polynomials arise in the solutions of these differential equations. Such other operational properties as the results of the Laguerre transform applied to the iterated operator $L^2[F(x)]$, to the processes of differentiation and integration, and to the inverse operator $L^{-1}[F]$ are treated.

An important phase in the study of any such operational calculus is the convolution property. The convolution property is the expression for the inverse transform of the product of two transforms. The form of the Laguerre convolution property found in this study depends upon the addition property

$$L_n(x)\, L_n(y) = \frac{1}{\pi}\int_0^{\pi} e^{\sqrt{xy}\cos\theta} \cos(\sqrt{xy}\sin\theta)\, L_n(x+y - 2\sqrt{xy}\cos\theta)\, d\theta$$

for the Laguerre polynomials. This form is derived here from an addition property for Sonine polynomials.

Transforms of particular functions are obtained. These include the transform of an exponential function, e^{tx}, $-\infty < t < 1$ and the function x^r, $r > 0$ a real number. The transform of a step function is obtained.

Application of the Laguerre transform to Laguerre's differential equation is considered. Applications of the Laguerre transform to partial differential equations are given.

The remainder of the study is devoted to obtaining properties of an integral transform based upon the Sonine (generalized Laguerre) polynomial. Several simple properties are obtained.

A substantial operational calculus has been developed for the Laguerre transform. The discovery of a convolution property for the Sonine transform would lead to a substantial operational calculus for that transform.

84 pages. $2.00.

ON THE ZEROS OF SUCCESSIVE DERIVATIVES OF AN ANALYTIC FUNCTION

(Publication No. 22,621)

Harvey Clarence McKenzie, Ph.D.
University of Colorado, 1956

Supervisor: Associate Professor Albert Edrei

The aim of this thesis is to throw some light on the behavior of zeros of successive derivatives of analytic function. We have used what seems to be the most powerful tool available, namely Nevanlinna's theory of meromorphic functions. The use of this theory leads to the investigation of three successive derivatives and it will be noticed that all our results are statements about such groups of three derivatives. It would be desirable to handle the case of n derivatives, or of all derivatives, but Nevanlinna's theory, in its present form, does not seem an adequate tool for such study.

Pólya conjectured that if a real entire function is such that all of its derivatives have only real zeros, then the function is of finite, order not greater than two. One could make some simplifying assumptions, for instance that g(z) has no zeros or few zeros, whereas g′, g″, g‴, . . . have only real zeros. On account of the peculiarities of Nevanlinna's theory, it is natural to limit the assumption of reality of zeros to g, g′, g″. This leads to the following theorem that was stated and proved by Edrei.

Theorem A. Let g(z) be an entire function of the form

$$(1) \qquad P(z)\, e^{Q(z)}$$

where Q(z) is any entire function and P(z) is an entire function of finite order. Assume that all but a finite number of the roots of the three equations

$$g(z) = 0, \quad g'(z) = 0, \quad g''(z) = 0$$

are real. Then the order ρ, of Q(z), is necessarily finite and does not exceed one.

This proposition runs parallel to Pólya's conjecture in as much as it enables us to limit the growth of g(z) by simply assuming that g(z) is of the special form (1) and that the zeros of g, g′, g″, are real. If we were able to use the reality of roots of higher derivatives, we would expect to obtain stronger limitations on the order and therefore to come closer and closer to Pólya's conjecture. Unfortunately we have been unable to do this but we have succeeded in generalizing Theorem A, in points which are essential to our purposes, by gradually relaxing, in the various statements of the following theorem, the restrictions relative to the special form (1).

Theorem 1. Let P(z) be an entire function, the zeros of which are all real. Assume that one of the two following relations is true.

$$(i) \qquad \overline{\lim_{r\to\infty}} \frac{\log_3 M(r,P)}{\log r} = \sigma\ ;$$

$$(ii) \qquad \overline{\lim_{r\to\infty}} \frac{\log_4 M(r,P)}{\log r} = \tau \quad (\tau < 1)\ .$$

Let Q(z) be any entire function and assume that all the zeros of each of the two functions $\frac{d}{dz}\{Pe^Q\}$, $\frac{d^2}{dz^2}\{Pe^Q\}$ are real.

Then

(I) if (i) is true, the order of Q(z) is finite and does not exceed max $[1, \sigma]$;

(II) if (ii) is true, we may only assert

$$\overline{\lim_{r\to\infty}} \frac{\log_3 M(r,Q)}{\log r} \le \frac{\tau}{1-\tau}\ .$$

The main interest of assertion (II) is to show that the possibilities of our method are now exhausted and that further generalization requires a different approach.

The solution to the problem of finding all entire functions such that g(z) has no zeros and g′(z) and g″(z) have only real zeros is summarized in the following theorem.

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Theorem 2. Let g(z) be an entire function and assume that
(i) g(z) has no zeros,
(ii) g′(z) and g″(z) have only real zeros (or no zeros at all).
Then g(z) must have one of the following forms

$$(2)\quad C \exp\left[\frac{e^{i(\alpha z+\beta)}}{4\theta} - \frac{i\alpha z}{4\theta}\right] \quad (0<\theta\leq 1)\ ,$$

$$(3)\quad C \exp\left[\gamma z\right]\ ,$$

$$(4)\quad C \exp\left[e^{i(\alpha z+\beta)}\right]\ ,$$

$$(5)\quad C \exp\left[\frac{\omega z^2}{2} + \beta z\right]\ ,$$

where α and β are real, ω is negative and γ and $C(\neq 0)$ are real or complex.

Theorem 2 generalizes substantially a theorem of Pólya and Saxer, who proved that the only entire functions f such that f, f′, f″ have no zeros are of the form f(z) = exp(az+b). Theorem 1 is used in the proof of Theorem 2.

We next widen the scope of the investigation by omitting the assumption that f(z) is entire and apply the Nevanlinna theory to obtain

Theorem 3. Let $\tau(>0)$ be the radius of convergence of the series

$$1 + z + \frac{\alpha}{2!}z^2 + \ldots = f(z)\ ,$$

and assume

$$\alpha \neq 1\ .$$

Then there exists a positive function $R(\alpha)$ (independent of f), finite if $\alpha \neq 1$ and such that either

$$\tau \leq R(\alpha)\ ,$$

or else

$$f(z)\cdot f'(z)\cdot f''(z)$$

vanishes at some point of the disk

$$|z| \leq R(\alpha)\ .$$

We constantly have

$$R(\alpha) \leq \frac{2+\epsilon}{|\alpha-1|}\log\frac{1}{|\alpha-1|} \quad \text{for } |\alpha-1| \leq A_1(\epsilon)\ ,$$

$$R(\alpha) \leq A_2(\epsilon) \quad \text{for } |\alpha-1| > A_1(\epsilon)\ ,$$

where $A_1(\epsilon)$, $A_2(\epsilon)$ are constants depending on ϵ and not on α or f.

The thesis concludes with three applications of Theorem 3 to a study of the location of the zeros of successive derivatives. 99 pages. $2.00. Mic 58-4835

LEGENDRE INTEGRAL TRANSFORMS

(L. C. Card No. Mic 58-973)

Alfredo Pinero-Perez, Ph.D.
University of Michigan, 1957

The purpose of this work is the study of Legendre integral transforms and their applications. With the aid of properties of these transforms it is possible to obtain solutions in terms of integrals of problems involving Poisson's equation and boundary values on a hemisphere and on octants of a sphere. This method consists in transforming the problem into a singular boundary value problem in ordinary differential equations.

Operational properties of three Legendre transforms have been derived. The main operational property of the odd transform has permitted the solution in closed form of boundary value problems when the solution is prescribed on the base of a hemisphere. The even transform has been used to solve problems when the normal derivative of the solution is given for the base of a hemisphere. The property giving the solutions of problems outside the hemisphere in terms of solutions of problems for the interior seems to be general.

A search of the literature by the author failed to disclose theorems similar to the following:

Theorem (1.2,2). Let $F(z) = \sum_{n=0}^{\infty} a_n z^n$ for $|z| < 1$, $|F(z)| < M$ in circular neighborhoods $N_1(e^{i\theta_0})$ and $N_2(e^{-i\theta_0})$ which are tangent internally to $|z| = 1$ at $z = e^{i\theta_0}$ and $z = e^{-i\theta_0}$ respectively. Then

$$\sum_{n=0}^{\infty} a_n P_n(\cos\theta_0) = \frac{1}{\pi}\int_0^{\pi} F(\cos\theta_0 + i\sin\theta_0\cos\phi)\,d\phi\ ,$$

in the sense of Abel summability;

Theorem (1.3,5). Let the Legendre-Fourier series for $T^{-1}[f(n)]$ converge boundedly to F(x) for $-1 \leq x \leq 1$. Then the Legendre-Fourier series for $T^{-1}[f(n)P_n(a)]$ converges for $-1 \leq a \leq 1$, $-1 \leq x \leq 1$; and

$$T^{-1}[f(n)\,P_n(a)] = \frac{1}{\pi}\int_0^{\pi} F(ax + \sqrt{1-a^2}\sqrt{1-x^2}\cos\phi)\,d\phi\ .$$

Theorem (1.2,2) has permitted the study of some questions concerning convergence and summability of Legendre series by means of radial limits of analytic functions. Theorem (1.3,5) affords a method of summing series involving products of Legendre functions. It has also been used in giving a proof of the convolution of Legendre transforms for a general class of functions and in obtaining closed form solutions for the above-mentioned boundary value problems.

Associated Legendre transforms have been introduced. They are applied, together with finite Fourier transforms, to problems on a hemisphere and on octants of a sphere. The problems considered in this respect involve three independent variables. It is shown that closed forms of the

solutions for problems with general boundary conditions can be given by using tables and the convolution property.

Some solutions of the problems considered have the structure of integral formulas of the Poisson type. In some instances, they are merely special cases of solutions already known for the sphere. In others, the formulas seem to be characteristic of problems for the hemisphere. Certain solutions have been compared with those obtained by using the Green's function, whenever this function can be calculated easily.

Part of the results consists of tables of Legendre transforms. Entries found in the literature are sometimes used to illustrate new methods of getting inverse transforms. Theorem (1.2,2) and theorem (1.3,5) have been useful in obtaining new entries. They also yield operational properties useful in calculating inverse transforms in terms of known functions. The dual operational properties which are proved have been valuable in extending the tables. The above procedures, among others, have been applied to obtain inverse transforms involving elliptic integrals, Bessel functions, Tschebyscheff polynomials, and Legendre functions.

A convolution formula of Hadamard, which can be applied to problems of Fourier series, has been employed frequently to arrive at operational properties.

In summary, the systematic study of Legendre transforms affords a natural method for solving problems involving Poisson's equation in spherical coordinates with boundary values prescribed on planes and on parts of the surface of a sphere. The solutions can be given in terms of integrals with the aid of tables and the convolution property. 109 pages. $2.00.

PERIODIC SOLUTIONS OF SINGULAR PERTURBATION PROBLEMS

(L. C. Card No. Mic 58-1137)

Edward Roy Rang, Ph.D.
University of Minnesota, 1957

Conditions are given which insure the existence and uniqueness of a periodic solution of the system of ordinary differential equations

$$(1)\quad \begin{cases} \dfrac{dx_1}{dt} = f_1(x_1, \cdots, x_m; y_1, \cdots, y_n; t; \epsilon) \\ \vdots \\ \dfrac{dx_m}{dt} = f_m(x_1, \cdots, x_m; y_1, \cdots, y_n; t; \epsilon) \\ \epsilon^{h_1} \dfrac{dy_1}{dt} = g_1(x_1, \cdots, x_m; y_1, \cdots, y_n; t; \epsilon) \\ \vdots \\ \epsilon^{h_n} \dfrac{dy_n}{dt} = g_n(x_1, \cdots, x_m; y_1, \cdots, y_n; t; \epsilon) \end{cases},$$

(where ϵ is a small positive real parameter and $h_1, h_2, \cdots, h_n$ are positive integers), when the reduced system (2) has a known periodic solution and ϵ is sufficiently small.

The periodic solution of (1) is constructed as a convergent series using a formal procedure originally employed by I. M. Volk (Akad. Nauk. SSSR, Prikl. Mat. Meh.: Vol. 10 (1946), pp. 559-574; Vol. 11 (1947), pp. 413-444; Vol. 12 (1948), pp. 29-38. In the analysis, several devices given by L. Flatto and N. Levinson (J. of Rat. Mech. and Anal., Vol. 4 (1955), pp. 943-950) are used. 86 pages. $2.00.

$$(2)\quad \begin{cases} \dfrac{d\varphi_1}{dt} = f_1(\varphi_1, \cdots, \varphi_m; \Psi_1, \cdots, \Psi_n; t; 0) \\ \vdots \\ \dfrac{d\varphi_m}{dt} = f_m(\varphi_1, \cdots, \varphi_m; \Psi_1, \cdots, \Psi_n; t; 0) \\ 0 = g_1(\varphi_1, \cdots, \varphi_m; \Psi_1, \cdots, \Psi_n; t; 0) \\ \vdots \\ 0 = g_m(\varphi_1, \cdots, \varphi_m; \Psi_1, \cdots, \Psi_n; t; 0) \end{cases}$$

THE TRANSFER OF GENERALIZING ABILITY FROM MATHEMATICS TO OTHER HIGH-SCHOOL SUBJECTS

(Publication No. 24,486)

Earl Clifton Rice, Ph.D.
George Peabody College for Teachers, 1957

Major Professor: Dr. F. Lynwood Wren

The purpose of this study was two-fold: (1) to construct a test for measuring the generalizing ability of senior high-school mathematics students, and (2) to determine whether or not there is measurable transfer of generalizing ability from mathematics to other subjects.

A five-option, multiple-choice test was constructed first. Ability to generalize was examined from the following aspects:

1. Ability to induce, infer, or derive general conceptions, principles, or inferences from a given set of examples, statements, or illustrations
2. Ability to give another example similar to several given examples each illustrating the same generalization

The test consisted of four sections: General Information, Social Science, General Science, and Mathematics. After the seventy-three items of a preliminary test had been validated, the vocabulary checked, difficulty indices made, and reliability established, desirable revisions were made and the test was reduced to sixty items.

It was administered to 522 beginning college freshmen at Central State College, Edmond, Oklahoma. Complete and usable information was available for 303 students who were divided, according to mathematics courses taken, into the following groups and their subgroups:

GROUP I---those having had one unit of Algebra I.
GROUP II--those having had one unit of Algebra I and one unit of plane geometry.
GROUP III- those having had one unit of Algebra I, one unit of Algebra II, and one unit of plane geometry.

Each group's subgroup included students who had had in addition one unit of general, composite, or applied mathematics. Fisher's t-test showed the difference of means of generalizing ability scores of each group and its subgroup to be insignificant. Therefore, combinations from a group and its subgroup could be used. The final grouping

included: Group I, 100 cases; Group II, 100 cases; and Group III, 50 cases.

The use of Fisher's t-test to check differences between the means of generalizing ability scores of these three groups, on each of the four test sections and on the total test, showed that the mean of Group III was higher than that of Group II and that of Group II was higher than that of Group I, for all comparisons. Nine of the twelve comparisons showed significant differences. On total test scores, all differences were significant beyond the 1 per cent level.

Each examinee also had a score on the American Council on Education Psychological Examination, 1948 Edition; a score for Part I of the American Council on Education Cooperative English Test, Form Y; and a high-school grade-point average. For convenience in handling, the groups were further reduced by random sampling to forty-eight cases each. Generalizing ability scores for each group were then divided into upper, middle, and lower intelligence groups as indicated by ACE examination scores. Stratifications similar to that based on intelligence were made in turn for vocabulary and for grade-point averages. Analyses of variance were made which showed highly significant differences between the groups in generalizing ability. They also indicated that this ability is related to intelligence, vocabulary, and grades.

Because significant correlations were found between generalizing ability and vocabulary (.73), intelligence (.70), and high-school grades (.28), analyses of covariance were made. These analyses showed that the groups still differed significantly in generalizing ability, even after they had been equalized relative to ACE examination scores, vocabulary scores, and grade-point averages. These remaining differences could not be attributed, then, to the three control variables. Since it had been shown that plane geometry and Algebra II brought about the improvement, it was concluded that generalizing ability did transfer from mathematics to other subjects.

203 pages. $2.65. Mic 58-4836

REGULAR CURVES ON RIEMANNIAN MANIFOLDS

(L. C. Card No. Mic 58-993)

Stephen Smale, Ph.D.
University of Michigan, 1957

A regular curve on a Riemannian manifold is a curve with a continuously turning non-trivial tangent vector. A regular homotopy is a homotopy which at every stage is a regular curve and keeps end points and directions fixed. A regular curve is closed if its initial point and tangent coincide with its end point and tangent. In 1937 Hassler Whitney classified the closed regular curves in the plane according to equivalence under regular homotopy. The main goal of this work is to extend this result to regular curves on Riemannian manifolds.

Let x_0 be a point of the unit tangent bundle T of a Riemannian manifold M. The space of all regular curves on M starting at the point and direction determined by x_0 is denoted by E. A map p from E onto T is defined by sending a curve into the tangent of its endpoint at its endpoint. The main theorem of this work is that the triple (E,p,T) has the covering homotopy property for polyhedra. Let Γ be the fiber over x_0 of (E,p,T) and let Ω be the ordinary loop space of T at x_0. A map $\varphi: \Gamma \to \Omega$ is defined as follows: If $f \in \Gamma$ let φf at t be the vector of T whose base point is f(t) and whose direction is defined by f'(t), the derivative of f at t. From the main theorem it follows that φ induces an isomorphism between the homotopy groups of Γ and Ω. Then it is shown that φ induces a 1-1 correspondence between the set of classes (under regular homotopy) of regular curves on M which start and end at the point and direction determined by x_0 and $\Pi_1(T,x_0)$. If f is a closed regular curve in the plane then its rotation number $\gamma(f)$ is the total angle which f'(t) turns as t traverses the unit interval. The Whitney-Graustein Theorem says that two closed regular curves on the plane are regularly homotopic if and only if they have the same rotation number. Using the fact that the unit tangent bundle of the plane is the product of the plane and the circle, this theorem follows from the previous work.

If f is a regular curve on M, φf is a curve, as we shall say, a lifted curve, on T. Clearly, not all curves on T are lifted curves. In particular, every lifted curve must be an integral curve of a canonical 1-form ω_0 on T. If the integral curves of ω_0 were exactly the lifted curves, the previous results could be obtained by proving theorems on integral curves. Unfortunately, however, ω_0 admits as integral curves some non-lifted curves. Nevertheless, these considerations raise questions concerning the loop space of integral curves of ω_0 on T. Let ω be a 1-form of a certain category (including ω_0) on a three dimensional manifold M and let $x_0 \in M$. Denote by Ω_ω the loop space at x_0 of piecewise regular curves on M which are integral curves of ω and by Ω the ordinary loop space of M at x_0. Then it is proved that the inclusion $i: \Omega_\omega \to \Omega$ induces an isomorphism between the homotopy groups of Ω_ω and Ω.

46 pages. $2.00.

STABILITY OF QUASI-LINEAR DIFFERENCE EQUATIONS

(L. C. Card No. Mic 58-1362)

J. Wolfgang Smith, Ph.D.
Columbia University, 1957

The dissertation deals with the Cauchy problem for the quasi-linear parabolic equation

$$(1) \quad \frac{\partial u}{\partial t} = a_0(x,t,u)\frac{\partial^2 u}{\partial x^2} + a_1(x,t,u)\frac{\partial u}{\partial x} + a_2(x,t,u).$$

Let the difference equation

$$(2) \quad u(x,t+\Delta t) = \sum_r c^r(x,t,u)u(x + r\,\Delta x,t) + \Delta t d(x,t,u)$$

be compatible with equation (1). The notion of local stability is defined for equation (2). Using the Brouwer fixed point theorem, it is shown that the solutions of a locally stable difference equation are subject to a priori estimates (which do not involve Δx). By means of such estimates, the following results are obtained: (A) Let the coefficients a_i satisfy a Lipschitz condition in u, and let u(x,t) be a solution of (1) such that u, $\partial u/\partial x$, $\partial^2 u/\partial x^2$, $\partial u/\partial t$ are uniformly continuous and bounded. The solutions $u(\Delta x)$

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of (2), determined by initial values u(x,0), will converge locally to u(x,t) as Δx tends to zero, provided (2) is locally stable. (B) Let the coefficients a_i have mixed partial derivatives in x & u up to order 6 and first derivatives in t which are uniformly continuous and bounded, and let a_0 be positive and bounded away from zero, all for $-\infty < x < \infty$, $0 \leq t \leq \tau_0$ & |u| bounded. Let u(x,0) belong to C^6. There exists a positive number $\tilde{\tau} \leq \tau_0$ and a solution u(x,t) of (1), which is defined and C^4 for $0 \leq t \leq \tilde{\tau}$ and assumes the initial values u(x,0). 27 pages. $2.00.

NONLINEAR VOLTERRA FUNCTIONAL EQUATIONS AND LINEAR PARABOLIC DIFFERENTIAL SYSTEMS

(L. C. Card No. Mic 58-1149)

James Juei-chin Yeh, Ph.D.
University of Minnesota, 1957

Adviser: Prof. R. H. Cameron

It was pointed out in (1) that there exists a certain duality between almost everywhere existence problems for solutions of nonlinear Volterra functional equations and minimality problems for positive solutions of certain linear parabolic differential systems. In this dissertation, two everywhere existence theorems for solutions of the functional equations are proved, from which, by means of the duality principle, three minimality theorems for positive solutions of the differential systems are derived. Also a uniqueness theorem for solutions of the differential system is derived from an existence theorem for solutions of the differential systems in (1), and then, by applying the duality principle, an almost everywhere existence theorem for solutions of the functional equations is derived. Finally another almost everywhere existence theorem for solutions of the functional equations which is a generalization to the n-dimensional case of a theorem in (2) is proved.
115 pages. $2.00.

1. R. H. Cameron. Nonlinear Volterra Functional Equations and Linear Parabolic Differential Systems, Journal d'Analyse Mathematigne Vol. 5. pp. 136-182. 1956/57.

2. R. H. Cameron. Differential Equations Involving a Parametric Function. (To appear in the Proceedings of the American Mathematical Society.)

MINERALOGY

PIEZOBIREFRINGENCE IN STRONTIUM TITANATE

(L. C. Card No. Mic 58-918)

Armando Alfonzo Giardini, Ph.D.
University of Michigan, 1957

This work represents the first stress-optical investigation of strontium titanate and the second such detailed study of a crystalline material. The following topics have been considered: (1) an historical review of developments in the field of stress-optics, (2) the synthesis and properties of single crystal strontium titanate, (3) equipment and procedure for specimen preparation, (4) experimental stress-optical equipment and procedure, (5) corrections for serious sources of experimental error, (6) interpretation of experimental data.

In this investigation both piezobirefringence constants for strontium titanate, namely $2q_{1212}$ and $(q_{2211} - q_{1111})$, have been accurately determined for the spectral range 4200-7700 Å in steps of 100 Å. Also, the absolute values of stress-optical constants q_{2211} and q_{1111} have been measured at 5400 Å by the prism deviation method. Strontium titanate becomes a negative biaxial crystal under a crystallographic diagonal stress and a negative uniaxial crystal when stressed along a crystallographic axis. The theoretical change in index of refraction under the effect of an hydrostatic stress has been calculated and found to decrease. The presence of piezobirefringent dispersion has been established for strontium titanate. A check of the stress-optical relationship has been carried out to a pressure of 350×10^6 dynes/cm^2, and found to be linear. The possibility of the presence of stress-optical hysteresis was investigated and found to be non-existent. The effect of non-homogeneous stress application has been theoretically investigated and an improved correction derived for use with parallel polars. An experimental proof of the correction has been carried out. The effect of orientational errors both for polars and crystal specimen also have been quantitatively evaluated. The applicability of piezobirefringent properties of crystals for the control and measurement of stresses and for the detection of crystal imperfections such as twinning in optically isotropic crystals has been recognized. 98 pages. $2.00.

GEOLOGY AND MINERAL DEPOSITS OF THE NORTHERN BIG BURRO MOUNTAINS-REDROCK AREA, GRANT COUNTY, NEW MEXICO

(L. C. Card No. Mic 58-927)

Charles Hayden Hewitt, Ph.D.
University of Michigan, 1957

The northern Big Burro Mountains-Redrock area, part of the Basin and Range province, is in Grant County, southwestern New Mexico. Precambrian metamorphic and igneous rocks underlie the northwest-trending mountains; Pliocene(?) Gila conglomerate and younger, unconsolidated gravels underlie the desert basin southwest of the mountains. North-dipping, Upper Cretaceous Beartooth quartzite and Colorado shale beds and early to middle Tertiary quartz latite-rhyolite flows cover the northern end of the mountains. Laramide and post-Laramide stocks and dikes

have been intruded into Precambrian, Cretaceous, and early Tertiary rocks.

The Precambrian metamorphic rocks include an older Bullard Peak series and a younger Ash Creek series, both of which occur as xenoliths and roof pendants in the Burro Mountains batholith. The Bullard Peak series is made up of interlayered quartz-feldspar gneiss, biotite gneiss, mica schists, hornblende gneiss, and amphibolite that were formed by dynamic metamorphism (amphibolite facies) or argillaceous feldspathic sandstone, calcareous argillaceous siltstone, shale, and dolomitic shale. These source sediments were intruded by diabase and leucogranite that were metamorphosed to hornblende gneiss and granite gneiss along with the sediments prior to the deposition and metamorphism of the Ash Creek rocks.

The Ash Creed series was derived from a sequence of shales, quartzose shale, feldspathic argillaceous sandstone, dolomitic sandstone, and siliceous dolomite that were first subjected to mild regional metamorphism, and then to three periods of contact metamorphism successively by anorthosite, diabase, and the Burro Mountains granite. The intrusion of diabase was primarily responsible for the formation of sericite phyllite; andalusite-sericite schist; cordierite, andalusite, and biotite hornfelses; diopside quartzite; and several varieties of serpentine-carbonate rocks.

Intrusion of the Burro Mountains batholith resulted in the development of metasomatic muscovite, microcline, and sillimanite and, by litpar-lit injection, converted part of the Bullard Peak hornblende gneiss and biotite schist to migmatite. Part of one migmatized hornblende gneiss xenolith contains orbicules. The granite enclosed mixed xenoliths of Ash Creek metasediments and diabase and converted the latter to metadiabase. The complex batholith is made up of several varieties of granite and lesser amounts of tonalite, granodiorite, pegmatite, and aplite.

Bullard Peak rocks have a well developed bedding foliation; lineation is minor. Local contortions and minor folds appear on northeast-trending major folds. The Ash Creek rocks are poorly foliated and not folded. Northwest- and northeast-striking normal faults of post-Upper Cretaceous age, which are partly controlled by Precambrian structures, are the dominant structural features. Dikes of diabase, andesite, monzonite porphyry, andesite porphyry, rhyolite and rhyolite porphyry, and basalt of Laramide and post-Laramide age have been localized by northeast-, northwest-, west-, and north-trending faults and shears.

Uplift of the Big Burro Mountains by means of faulting along northwesterly faults on the southwest mountain flank and along northeasterly cross faults began in late Cretaceous-early Tertiary time. The Gila conglomerate formed by the merging of fanglomerates on the mountain flanks. Continued uplift and a change to an arid climate in late Tertiary-Quaternary time resulted in pedimentation on the mountain flank, dissection of Gila conglomerate, and deposition of bajada and bolson deposits in the basin to the southwest.

Precambrian metamorphic deposits of serpentinite, asbestos, and magnetite in the Ash Creek rocks are of mineralogical significance only. Laramide and post-Laramide hydrothermal veins related to stocks and dikes of intermediate composition contain fluorite and manganese oxides as well as minerals containing W, Cu, Pb, Zn, Ag, and U. Over a million dollars in silver and several thousand tons of fluorite have been produced from the area. Significant production in the future is dependent upon the discovery of new ore bodies or extensions of deposits already known. 391 pages. $5.00.

MUSIC

THE MASSES OF JOHANN CASPAR KERLL (VOLUMES I AND II)

(L. C. Card No. Mic 58-919)

Albert Cornelius Giebler, Ph.D.
University of Michigan, 1957

The purpose of the study of the Masses of Johann Caspar Kerll (1627-1693) is to establish his style of composition in light of developments of Mass composition during the seventeenth century. Several present-day writers agree that Kerll stood at the apex of the growth of the concertato style in South-Germany and rank him with Alessandro Scarlatti and Marc-Antoine Charpentier as one of the most important composers of Catholic Church music in the generation following Giacomo Carissimi. Bach admired Kerll's works, and Handel adopted passages from some of Kerll's works for development in his own. For these reasons the Masses of Kerll were chosen for study.

Kerll's musical talent was recognized early in his life by the Austrian Archduke Leopold Wilhelm, who sent him to Vienna to study with Giovanni Valentini, and later to Rome to study with Carissimi. Subsequently, Kerll became organist to the archduke, then serving as Spanish viceroy at Brussels (c.1646-1656), Capellmeister to the Elector Ferdinand Maria in Munich (1656-1673), organist at St. Stephen's Cathedral in Vienna (1674-1677), and organist at the court of Emperor Leopold I in Vienna (1677-1692). Kerll composed most of his Masses during the mature years of his life in the imperial city. His heritage as a Mass-composer includes not only the works of Valentini and Carissimi, but also those of Palestrina, Viadana, Benevoli, and Monteverdi.

Sixteen Masses by Kerll have been preserved, three of them as Kyrie and Gloria fragments. Only one of the works, a Requiem, follows the traditional a cappella style, the others are composed in the concertato style of the period. The most important facets of his style are (1) clear designation of performing mediums, including solo and ripieno voices, instruments, and tutti; (2) regular alternation of these mediums; (3) a high development of thematic unity; (4) complete command of contrapuntal textures and a standardization of fugal forms for the close of all five of the main sections of the Mass; (5) respect for multiplicity of modes, yet appreciation of the basic elements of major-minor tonality and functional harmony;

(6) expressive use of established dissonance treatment; (7) gently rising and falling melodic lines with varied embellishments in many solo sections; (8) rather frequent meter changes; and (9) effective word-painting.

The influence of Kerll's style may be seen in works of later Viennese composers, such as Johann Joseph Fux, one of Kerll's last pupils, and Antonio Caldara, Fux's assistant Capellmeister at the emperor's court. Even the Missae Breves of Haydn and Mozart represent a tribute to their older predecessor.

There can be no doubt that Kerll's Masses represent the culmination of a style. They are significant works of art, worthy of a prominent place in music history, of renewed publication, and of present-day performance. To further the possibility of such performance, two representative complete Masses by Kerll, scored from the earliest partbooks, make up the second volume of the dissertation. Included are the Missa in Fletu Solatium Obsidionis Viennensis for soprano, alto, two tenors, bass (solo and ripieno), two violins, four viols, and basso continuo; and the Missa Superba for two choruses in eight voices, two violins, four trombones, violone, and basso continuo. While the first work is available in a nineteenth-century manuscript score, to the writer's knowledge, this is the only complete score of the Missa Superba.

553 pages. $7.05.

STYLISTIC CHARACTERISTICS AND TRENDS IN THE CHORAL MUSIC OF FIVE TWENTIETH-CENTURY BRITISH COMPOSERS: A STUDY OF THE CHORAL WORKS OF BENJAMIN BRITTEN, GERALD FINZI, CONSTANT LAMBERT, MICHAEL TIPPETT, AND WILLIAM WALTON

(L. C. Card No. Mic 58-651)

George E. Hansler, Ph.D.
New York University, 1957

The purpose of this investigation is to determine the stylistic characteristics and trends in the choral music of five twentieth-century British composers: Constant Lambert (1905-1951), William Walton (b. 1902), Michael Tippett (b. 1905), Gerald Finzi (1901-1956), and Benjamin Britten (b. 1913).

Choral music of Great Britain rather than that of some other country was chosen as the subject of the study because of the high place that choral art has traditionally occupied in the musical life of Britain, and because of the great interest that contemporary British composers (particularly those of this study) have displayed in writing for the choral medium.

In order that the music of these composers might be considered in the light of its historical background, a résumé was made of the main technical features of style of the nineteenth and twentieth centuries with particular attention to the music of the British composers immediately preceding the group of five. This résumé is based on secondary sources.

The determination of the stylistic characteristics of the choral writing of the five selected composers was accomplished by the detailed analysis of their compositions. The description of the analysis of each work (or group of works) and the summary statement for each composer are organized according to the following: (1) special features relating to the text (e.g., use of melisma and symbolism), (2) formal structure, (3) harmonic structure, (4) melodic features, (5) rhythmic features, (6) use of special choral idioms, and (7) range and spacing of voice parts.

Musical style is defined in this study as the product of various combinations of a large number of technical elements. The investigation is concerned primarily with the nature and treatment of the elements that comprise the works of the selected composers. Because of their multiplicity and the complexity of the treatment, no valid summary of the styles can be given in a few sentences. The examples of characteristic features in the music of certain of the composers are given below in order to illustrate the type of finding of the research, but these are not to be regarded as summarizing statements or as necessarily representing the most important features of the choral styles. Examples: Tippett employs highly chromatic melody lines, these often involving groups of three adjacent notes in half-step relationship and in all possible arrangements. When combined, the chromatic lines produce a dissonant harmonic result that gives the impression of vague and continuously shifting tonalities. An important feature of Walton's choral music is the frequent use in accompaniments of running melodic lines that impart an ornamental complexity, almost confusion, to the music. He achieves highly dramatic effects at certain climaxes in some works by the use of the fortissimo appoggiatura sounded against its note of resolution. Britten's choral music abounds with the imaginative treatment of a very large vocabulary of musical devices. An example is seen in the handling of the pedal device in the Festival Te Deum; here reiterated pedals on three pitches are retained after two changes of key, the pedal assuming new relationships to the new tonics.

When the choral works of the five composers are compared with each other and with the music of their English predecessors, no major trends of a decisive nature are apparent. Some general tendencies, however, may be noted, these in most instances being of a negative type. For example, there is a disposition to use in only a limited way, or to avoid altogether, some of the more radical techniques of the twentieth century, such as polytonality and the twelve-tone idiom. For the most part, they have eschewed these generally very dissonant and tonally complex techniques in favor of a style that retains some of the "sweetness" that appears to be a national characteristic of Britsh music.

731 pages. $9.25.

MARIN MARAIS, 1656-1728 (VOLUMES I AND II)

(L. C. Card No. Mic 58-1006)

Clyde Henderson Thompson, Ph.D.
University of Michigan, 1957

Marin Marais was the central figure in the French school of bass-viol composers and performers that flourished in the late seventeenth and early eighteenth centuries. He spent his entire life in Paris, and the greater part of it in royal service. First appointed as Ordinaire

de la Musique de la Chambre du Roi in 1685, he retained that post throughout the reign of Louis XIV, and from 1715 to 1725 served under the regency and Louis XV. His contemporaries recognized him as an outstanding performer and a composer of stature, whose works for the bass-viol and the operatic stage were known beyond the boundaries of France.

In spite of the reputation achieved during his life-time, little has been written about Marais' life and works. Musical historians from Hawkins and Burney down to the present have accorded him, at least, passing mention, and some have extolled the quality of his compositions. In recent years, several provocative, though limited, studies have whetted interest in his undeservedly neglected works. The poverty of available information seems particularly curious since the period in which he lived produced some of the most important developments in the history of string music.

The present monograph includes a volume of historical and analytical studies and a volume of music by Marais in modern edition. The first volume begins with a brief history of the viols, their development, and literature prior to the appearance of Marais' publications. A biographical chapter, based on contemporary accounts, collates the known facts of his life and musical activities. The five published collections of his pieces for one, two, and three bass-viols, which constitute the special focus of the investigation, are discussed in detail. The core of the study is devoted to an examination of Marais' musical style as revealed in these works. It includes separate chapters dealing with his instrumental idioms, harmonic technique, rhythmic characteristics, and formal structures. The final chapter of the first volume offers an evaluation of Marais' historical position in relation to his contemporaries.

The second volume comprises a selected group of Marais' compositions for one, two, and three bass-viols and figured bass. The preface to the works includes a discussion of the editorial policies that guided the transcription of the pieces and a table of the ornamental signs employed. Except in the works for two and three viols, no attempt has been made to include complete suites. Since the French suite in this period frequently is a lengthy anthology of pieces rather than a set of related works, the individual compositions for one viol were chosen for their intrinsic musical worth and for the manner in which they illustrate the several aspects of Marais' style. Curt Sachs has stated that Marais' compositions for viols constitute one of the most important documents in the history of French instrumental music. The works selected, appearing for the first time in modern edition, amply justify the praise bestowed on Marais by contemporaries and historians. 630 pages. $8.00.

PHARMACOLOGY

A STUDY OF THE NATURE OF THE d-TUBOCURARINE DEPOT

(L. C. Card No. Mic 58-1070)

Edmund George Anderson, Ph.D.
University of Washington, 1957

The literature regarding the fate of an injected dose of d-tubocurarine was reviewed and the existence of a curare depot was established. The hypothesis is put forth that heparin might be acting as the d-tubocurarine depot. Using the isolated frog sciatic nerve- sartorius muscle preparation and the dog and cat sciatic nerve-tibialis muscle preparation to measure the effect of d-tubocurarine, this hypothesis was subjected to experimental test.

An initial test of the hypothesis was made by determining the ability of heparin to antagonize the action of d-tubocurarine. It was found that exogenous heparin was capable of antagonizing the action of d-tubocurarine when given in appropriate doses. The effect of the potent heparin antagonist protamine on the duration of action of d-tubocurarine was also measured in an attempt to evaluate the role of endogenous heparin. Protamine was found to be a very potent potentiator of d-tubocurarine, but it was also found to possess a weak neuromyal blocking effect of its own. This direct action of protamine makes it difficult to evaluate the role of protamine's anti-heparin action in prolonging the duration of action of d-tubocurarine.

The role of the mast cell, which contains the endogenous heparin, was then investigated by using histamine liberators to disrupt the mast cells. Tween 20 and polyvinylpyrolidone (PVP), two potent histamine liberators, were found to potentiate the duration of action of d-tubocurarine many times. Their ability to potentiate d-tubocurarine was found not to be mediated by any direct blocking of neuromyal transmission, concurrent blood pressure fall, or by the released histamine. However, the ability of Tween 20 and PVP to potentiate d-tubocurarine closely paralleled their potency as histamine liberators. It was thus concluded that the disruption of the functional integrity of the mast cells results in a prolongation of the duration of action of d-tubocurarine. Therefore these results offer support to the postulate that the mast cell is functioning as a d-tubocurarine depot. 68 pages. $2.00.

AN ANALYSIS OF THE FACTORS INFLUENCING THE DEVELOPMENT OF PHYSICAL DEPENDENCE TO NARCOTIC ANALGESICS IN THE RHESUS MONKEY WITH METHODS FOR PREDICTING PHYSICAL DEPENDENCE LIABILITY IN MAN

(L. C. Card No. Mic 58-900)

Gerald Antonine Deneau, Ph.D.
University of Michigan, 1957

Several members of each of the five chemical classes of narcotic analgesics known to produce physical

dependence in man were studied in the Rhesus monkey with reference to:

(1) their ability to produce physical dependence;

(2) the characteristics of such physical dependence (as evidenced by abstinence signs) and their relationship to morphine dependence as a standard;

(3) their ability to suppress morphine abstinence signs or to support morphine dependence.

The studies were designed to evaluate the parameters of (a) frequency of drug administration, (b) total daily dose, and (c) duration of chronic administration on the development of physical dependence.

The following facts were determined:

(1) All narcotic analgesics studied which produce physical dependence in man also do so in the monkey.

(2) The characteristics of abstinence which occurs after chronic poisoning are distinct for each drug. The widest spectrum of signs occurs in morphine abstinence.

(3) In some instances abstinence involves primarily somatic signs, in others, autonomic signs.

(4) Drugs may be roughly divided into two types, with respect to their dose-response curves as related to their requirements for inducing physical dependence. Some agents, of course, have dose-response curves showing characteristics of each type.

Type A. Agents whose degree of effect, but not duration of action, is markedly increased with increasing doses.

Type B. Agents whose duration of action, but not degree of effect, is markedly increased with increasing doses.

(5) The optimal production of physical dependence in the monkey requires (a) that the frequency of drug administration provide continuous and fairly uniform drug effect; (b) that the intensity of drug effect be adequate—implying a minimum daily dose requirement; (c) continuous administration of such frequency and dosage as indicated in (a) and (b) for a period of one month.

(6) Whereas the maximal degree of physical dependence may only be reached after more prolonged poisoning (e.g., six months with morphine), the degree which exists at one month is nearly complete.

(7) All agents which induced physical dependence, with the exception of Dextrorphan, are capable of suppressing some or all of the signs of morphine abstinence.

(8) The qualitative occurrence of specific abstinence signs upon withdrawal of each agent correlates with its capacity to suppress these same signs of morphine abstinence.

(9) The qualitative and quantitative aspects of physical dependence to each drug in the monkey correlate well with those in man when proper conditions of drug administration are met.

(10) Nalorphine-induced withdrawals are comparable to those seen upon abrupt withdrawal with all agents except Dextrorphan.

On the basis of these facts, two methods are proposed for screening physical dependence liability in the monkey as a basis for predicting such liability in man.

Method A. Suppression of Morphine Abstinence Signs and Support of Morphine Physical Dependence.

A preliminary estimate of a new drug's capacity to produce physical dependence can be obtained in two days by determining its ability to suppress morphine abstinence. For this, a double-blind technique is used, in which several doses of the test drug and of morphine are each administered to groups of five morphine-abstinent monkeys. The test drug's capacity to induce a low, intermediate or high degree of physical dependence can then be predicted from its pattern of suppression.

Method B. The Production of Physical Dependence.

This method provides the best assay of physical dependence liability of a test drug but requires chronic administration for one month meeting the dosage requirements noted above. Physical dependence, different in nature from that of the opiates, such as develops to Dextrorphan, is demonstrable by this technique.

189 pages. $2.50.

CELLULAR DISTRIBUTION OF NARCOTIC DRUGS

(L. C. Card No. Mic 58-961)

Lawrence Bruce Mellett, Ph.D.
University of Michigan, 1957

The techniques of histochemistry have had only limited application to pharmacological problems. It was the aim of this study to combine the techniques of histochemistry and pharmacology in an attempt to localize certain central nervous system depressants, viz., morphine and a synthetic morphine-like compound, levorphan.

A comprehensive survey was undertaken to establish satisfactory methods of tissue fixation and methods of drug detection in the fixed tissue. In general, classical fixatives proved unsatisfactory because they caused diffusion of the drug from the tissue. Freezing-drying techniques, though satisfactory from the aspect of the diffusion problem, were too slow and cumbersome for routine use. The use of fresh frozen sections was precluded on a theoretical basis. Fixation of tissues with p-dioxane was finally selected for routine use since it provided satisfactory sections with respect to morphology with little or no drug diffusion. Attempts to localize the drug by means of classical histochemical staining procedures were unsuccessful because of either a lack of sensitivity or specificity.

The availability of C^{14} labeled levorphan tartrate made the localization of this material possible. The problem was approached by two experimental techniques. Tissues from albino rats which had received 50 mgm./kgm. of the labeled drug were homogenized in 0.85M sucrose or in 0.9% saline and the component parts of the cells were separated by differential centrifugation. The separated components were then dried and characterized with respect to weight, nitrogen content and numbers of identifiable morphological components. The drug was then extracted from the dried component, plated on aluminum planchets and counted in a Nuclear Gas Flow Counter.

The distribution studies by means of mechanical separation techniques produced a typical localization of C^{14} levorphan in brain, kidney and liver. In all tissues the nuclear concentration of the drug was quite low, ranging from 1.4 millimicrogm. (m γ) of drug/mgm. and 22.1 m γ/mgm. for liver and kidney, respectively. The level of drug in the

mitochondrial fraction was 4.3 m γ/mgm., 67.7 m γ/mgm. and 24.5 m γ/mgm. for brain, liver and kidney, respectively. The microsomal fraction showed values of 4.6, 87.3 and 60.7 m γ/mgm. for these tissues, while for the soluble fraction the values were 1.7, 96.3 and 76.3 mγ/mgm., respectively.

In addition to mechanical separation techniques, autoradiographs of dioxane fixed tissues were prepared for purposes of comparison. The qualitative distribution of the drug was determinable in kidney and in liver; however, it was not possible to demonstrate radioactivity in brain sections employing these techniques. In general, the findings from autoradiographic techniques complement the findings from cell fractionation studies. 110 pages. $2.00.

PHILOSOPHY

AN EXAMINATION OF THE CURRENT STATUS OF NATURAL LAW PHILOSOPHY

(L. C. Card No. Mic 58-892)

John Robb Carnes, Jr., Ph.D.
University of Michigan, 1957

Natural law philosophy is one of the oldest and strongest traditions in the history of moral, legal, and political thought. In the nineteenth century and the early part of the twentieth, however, natural law theory suffered a period of comparative obscurity, from which it is only recently showing signs of revival. It is this "renaissance of natural law theory" which prompts the investigation comprised by this dissertation.

This investigation has essentially three objectives: to define natural law philosophy, to explore its current status, and to study its tenability in the light of modern ethical thought.

A tentative definition of natural law theory is attained by examining a number of definitions suggested by recent authors and extracting from them a set of characteristics which seem to be agreed on as common and peculiar to all the various kinds of natural law theories. The adequacy of the definition of natural law philosophy which results from taking these characteristics as necessary and sufficient criteria of a natural law theory is then tested by determining its ability to account for the essential features of certain paradigmatic instances of natural law philosophy: Cicero, Aquinas, Grotius, Pufendorf, Hobbes, and Locke. Having established their adequacy, the criteria are used to decide whether two "doubtful" moral theories (those of Richard Price and Immanuel Kant) qualify as natural law theories.

An examination is then made of several areas of contemporary thought—legal philosophy, Thomism, Protestant Neo-Orthodoxy, and semitechnical, nonacademic political thought—to assess the significance and philosophical merit of the current "revival" of natural law theory. It is found that while the revival may be indicative of the direction in which contemporary thought in these areas is moving, it is of no great intrinsic philosophical importance.

A study of certain representative modern moral philosophers, however, reveals that in some varieties of moral theory, especially intuitionism and naturalism, a considerable amount of natural law philosophy is actually being done, though it may not be labeled as such. Moreover, it is shown that there is an even wider range of moral philosophy which is logically compatible with natural law theory, and that this range even includes some modified forms of noncognitivism.

This compatibility shows that natural law philosophy is not a unique type of moral theory. This is of considerable importance to the legal and political philosopher, since he can now make use of the concept of natural law without having to enter into the modern ethical controversy in order to defend it. But so far as moral philosophy proper is concerned, a natural law theory cannot constitute an adequate position, since, being compatible with a variety of ethical theories, it does not involve a view as to the basic questions at issue between those theories.

A brief study is made of several important objections to natural law philosophy, and replies to the objections are suggested. 270 pages. $3.50.

WOLFGANG KOEHLER'S CONCEPTION OF DIRECT EXPERIENCE

(L. C. Card No. Mic 58-893)

James Wilfred Clark, Ph.D.
University of Michigan, 1957

This study attempts to answer the following questions:

1. What precisely does Koehler mean by the term "direct experience"?
2. How does he use the conception of direct experience in dealing with problems of an epistemological or metaphysical character?
3. What can be said for and against Koehler's conception of direct experience, especially insofar as it is expressed in or implied by replies to the preceding questions?

Answers to these inquiries are provided by a critical examination of philosophically interesting portions of Koehler's writings. His Gestalt Psychology, The Place of Value in a World of Facts, and a number of articles on theoretical psychology and philosophy published during a thirty-year period beginning in 1912 are the principal sources of information.

With regard to the first question, this study points out that Koehler makes use of "direct experience" in referring to many different "mental" occurrences. These include cases of perceiving objects, feeling emotion, having afterimages, and feeling pleasure or pain. His application of "direct experience" presupposes a distinctive epistemological analysis and metaphysical classification of occurrences named by the term. Furthermore, Koehler's way of speaking involves the adoption of a set of perceptual terms, the members of which bear a superficial

resemblance to expressions used in everyday language. This study attempts to state in a systematic way what is meant by sentences which make use of the new terms. It also tries to state clearly what Koehler means when he substitutes "immediate experience" for "direct experience," and concludes that both psychological and epistemological immediacy are attributed to instances named by these terms.

The second question is answered by examining Koehler's discussion of two problems. One is the task of supporting belief in the existence of transphenomenal entities. The other is the endeavor to determine whether or not direct experiencing of causally related things occurs. Solutions offered by Koehler are studied and the employment of his conception of direct experience in formulating them is exhibited. Distinctive features of directly experienced causes are identified and Koehler's notion of causal necessity is explicated.

In reply to the third question it is arged, first, that Koehler's appeal to a causal theory of perception is unsatisfactory. He maintains both that scientific knowledge of physical things provides evidence concerning the origin of phenomenal things as well as that direct experience of phenomena is a source of evidence justifying belief in the existence of physical things. Second, Koehler appears to regard the origin of phenomena as having a bearing on their role in cognition, although he fails to show that this is so. Third, Koehler's conception of direct experience may be given a conventionalistic interpretation. His basic doctrines concerning phenomena and their relations to physical things are then shown to be prescriptions or stipulations rather than truths. Fourth, both his argument from phenomena to transphenomenal entities as well as his claim that there are instances of direct experiencing of causally related phenomena are open to serious objections. Lastly, the great virtue of Koehler's conception of direct experience consists in his persistent, thought-provoking emphasis upon certain features of the empirical data available to percipients, such as the presence of "understandable" relations and the appearance of structure in the data ab initio. 172 pages. $2.25.

CAUSAL RELATIONS BETWEEN MIND AND BODY: A NEW FORMULATION OF THE MIND-BODY PROBLEM

(L. C. Card No. Mic 58-1428)

David Randall Luce, Ph.D.
University of Michigan, 1957

It is sometimes asserted that there is no mind-body problem, because the alleged problem depends on certain metaphysical presuppositions which need not be assumed. The purpose of this dissertation is (a) to show that there is a mind-body problem, (b) to formulate a number of proposed solutions to the problem, and (c) to define the major issues standing between them.

The argument for the existence of a genuine mind-body problem consists of the formulation of a number of propositions, each defining a theoretically possible mode of causal relationship between mind and body. The propositions are formulated in a terminology which is metaphysically "neutral," neither presupposing the bifurcation of mind and matter, nor the substantiality of minds, nor the non-substantiality of minds. The traditional positions (Interactionism, Parallelism, Epiphenomenalism) are defined in terms of combinations of various propositions. The fact that alternative theories, each having some prima facie plausibility, can be formulated in a metaphysically neutral terminology defines the mind-body problem: the task is to determine which of the theories is true.

In order to develop a terminology free of metaphysical comitments I introduce the concepts of "mental events" and "physical events." I also introduce a symbolic notation capable of expressing causal propositions. I can then define the various possible forms of the action of body on mind, the action of mind on body, theories of the causation of mental events, and psycho-physical correlation in terms of causal and extensional relationships between mental events and physical events.

I find that the idea of the action of mind on body has meant different things to different writers, and formulate several versions of the view: some quite strong, some quite weak. The strong forms of the action of mind on body entail the falsity of psycho-physical correlation, although this has not always been recognized by its advocates. Thus I find that the truth or falsity of psycho-physical correlation is a pivotal question for the mind-body problem.

The truth or falsity of psycho-physical correlation is an empirical question of fact. But for those forms of Interactionism, Parallelism, and Epiphenomenalism which presuppose the truth of psycho-physical correlation, the questions at issue are not questions of fact capable of definition in an extensional language, but rather questions of the proper analysis of the causal relation, and metaphysical views concerning the status of mind and matter.

I examine the positions of Santayana, Cohen, and others, to show that it is their respective theories of causation, rather than questions of physiological or psychological fact, which commit them to their respective positions.

I conclude by showing that any theory of causation sharing certain characteristics of the Humean theory entails (supposing the truth of psycho-physical correlation) a position in which Interactionism and universal physical determinism are both true together, and argue that this represents the most satisfactory solution to the dilemma of the mind-body problem. 199 pages. $2.60.

THE PROBLEM OF A SCIENCE OF ETHICS IN THE PHILOSOPHIES OF JOHN DEWEY AND BERTRAND RUSSELL

(Publication No. 25,456)

John L. McKenney, Ph.D.
The Ohio State University, 1952

If one were asked to name two philosophers who most nearly embody the spirit and temper of our contemporary scientific age, the names, John Dewey and Bertrand Russell, might very well come to mind. Although Dewey and Russell are models of the contemporary scientific philosopher, they disagree in the most extreme terms concerning the possibility of a science of ethics. Dewey's position not only allows but actually requires the methods of science to

be extended to the sphere of values, while, on the contrary, Russell's stand seems to prohibit science from treating ethics. The problem of the dissertation was to explain this radical disagreement and to investigate the possibilities of reconciling their divergent views.

It was first necessary to consider each man's basis for taking his particular stand on the issue. Once this was done, their reasons for differing in their conclusions could be determined even though a survey of their respective philosophical convictions reveals a wide range of general agreement.

Dewey's conception of science permits a science of valuation. Science for him is one activity among the many activities which make up the continuum of life's experience.[1] Scientific knowledge is not marked off and separated from everyday, common-sense experience in a way that makes it inapplicable to the very process of experience out of which it grew. Essentially science is an activity, a work, performed in special laboratories, by men trained in certain ways.[2] Science is not entitled to veneration or praise as a special kind of knowledge which demands awe-imspired reverence on the part of the uninitiated.[3]

Knowledge, for Dewey, is a result of the process of inquiry.[4] Inquiry begins as an investigation into a disturbed, unsettled situation or experiential setting. By selecting the aspects of the situation which constitute the problem and framing a hypothesis to guide future action aimed at resolving the problem, inquiry proceeds.

Knowledge, or the termination of inquiry, results from the resolution of the problem which was being considered.[5] Of course, in the various particular scientific areas the elaborateness of the activities necessary to resolve the problem varies, but since all knowledge follows from the general process of inquiry, science is actually the working out in particular situations of that process.

The same pattern of inquiry is present in Dewey's theory of valuation. In fact, Dewey explicitly said that his theory of value judgments is but a special case of his general theory of inquiry.[6] Since the same process of inquiry is central to science and to valuation, there is no barrier to a science of ethics.

For Dewey, a separation between facts and values does not exist. Facts as well as values are accounted for exhaustively in terms of the conditions and conclusions of inquiry, and neither has any status prior to inquiry, or independent of it.[7]

Science for Russell means a body of knowledge reporting particular matters of fact and also a collection of principles and laws which make the prediction of future events possible.[8] Science is both scientific knowledge and scientific technique.[9] The former consists of the formulation of true propositions which accurately report the factual nature of the world. Scientific technique, on the other hand, is not interested merely in recording the facts, but in providing a means for altering the state of things.

Science as knowledge is not able to deal with ethical problems because there are no facts in ethics.[10] Since facts are what make propositions true or false, and knowledge consists of the awareness of true propositions, the absence of a factual basis in ethics puts that area of man's experience outside the scope of science.[11]

Ethical sentences are purely emotive-persuasive and have no indicative function, according to Russell, because ethics deals with feelings, passions, and desires. There are no ontologically objective values for Russell. Whether or not something produces the satisfaction of desire for someone determines its being good or bad.[12] Value statements evince desires but do not state that we have certain desires.[13] If ethical judgments have no indicative function, then knowledge of ethical matters is impossible. Wherever knowledge is not possible, there science cannot go, except as technique.

However, science as technique is regarded by Russell as a neutral instrument. Scientific technique, according to him, can produce either good or bad results and in itself is completely neutral to the ethical value of the uses to which it is put.[14] Of course, the very neutrality of technique allows it to be applied where mere questions of selecting proper means for already accepted ends are involved. But this is not to be considered a point for a science of ethics, for the real problems of ethics involve deliberation over end-values. Here science is impotent.

A survey of the general areas of agreement between the positions of Dewey and Russell narrows the range within which the key to their differences concerning a science of ethics must lie. Russell has said of Dewey, "With most of his opinions I am in almost complete agreement."[15] In theories of education and psychology their positions are quite similar. As Eduard Lindeman writes, "Russell's treatment of such problems as fear, punishment, truth-telling, et cetera, conforms in general to the precepts known in this country under the title of progressive education,"[16] and Justus Buchler has observed that the principle of growth is central in Russell's ethical position,[17] which accords with Dewey's stand that growth is the only moral end.[18] In social and political philosophy, as in their philosophies of religion, these two men's respective views are very similar.[19] Possibly most important is their mutual respect for science as the true means of knowledge and improvement for mankind. Scientific knowledge for Dewey and Russell represents the only acceptable type of knowledge.[20]

If Dewey and Russell differed concerning the nature of value, their split over the possibility of a science of ethics would be easily explained. However, they agree generally that the origin of value is in desire and that value can be defined in terms of desire-satisfaction under certain specifiable conditions.[21]

The only relevant differences in their philosophies concern the theory of knowledge. Since each man's own theory of knowledge figures so prominently in his acceptance or rejection of a science of ethics, it is necessary to determine those points of Dewey's theory of knowledge which are not acceptable to Russell. His chief criticism of Dewey's epistemology stems from Dewey's substitution of inquiry for truth as the basic concept.[22] Russell cannot accept Dewey's rejection of a factual reference for propositions as entirely outside the scope and range of the inquiry's conditions. He feels that once science or inquiry has given up its claim to objective facts, entirely independent of the actions of the observer, then there is no way of establishing true scientific results. If truth is determined by whether the results of inquiry are satisfying or not, and if the impartial investigator cannot claim recognition for his results because his inquiry is factual, then those persons having the balance of power can control science,[23] because whether or not certain results are satisfying is within the power of forceful persuasion to determine.

Dewey does not feel that the whole of Russell's

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criticisms are drawn from his own position; nevertheless, they do not agree upon the nature of knowledge and science, in general, and the nature and function of propositions, in particular.[24] For Dewey they are merely instruments within inquiry, while Russell's theory of propositions gives them a status apart from inquiry so that the attainment of true propositions is actually the goal rather than a mere instrumentality within inquiry.[25] Dewey and Russell also differ in their interpretation of the role of operations and instrumentalities within scientific inquiry, as well as in their interpretation of the function of antecedents and consequences in determining truth.[26] The whole issue of the relation of perception to empirical knowledge provides another point at which they do not agree.[27]

There is an alternative solution if Dewey's position might reject the possibility of a science of valuation in favor of Russell's viewpoint, but there is no way in which Dewey's stand can be transformed into Russell's rejection of the science of ethics. The concepts of value, knowledge, inquiry, and science are too intricately bound up with one another in Dewey's philosophy for any other conclusion than the possibility of a science of valuation.[28]

Another alternative for some degree of agreement between Dewey and Russell concerning a science of ethics lies in finding the basis for such a science within Russell's philosophy, but he states that ethics is barred from the realm of science because there is no factual reference for ethical statements.[29] Still another alternative would involve demonstrating that basic propositions in ethics are possible within Russell's own position, since it has been held that Russell's writings over the past fifty years exemplify the common trait of being centered around a core of method, or philosophical analysis.[30] This method is known as the theory of descriptions and has been applied in diverse areas of thought as a technique by which certain symbols that are defective are replaced by other symbols or groups of symbols. This technique has been applied by Russell in ontological analysis, formal analysis in abstract cosmology, logical analysis in mathematical logic, and in the analysis of the symbolism of science and ordinary life. The theory of descriptions starts from the distinction between a name, which refers directly to what it means and has its meaning independently of other words,[31] and an incomplete symbol, which has no meaning in itself, but only acquires meaning when it is considered in a context with other symbols.[32]

A definite description is a phrase of the form "the so-and-so," which also complies to the form of a denoting phrase.[33] A phrase is denoting because of its form alone; therefore, it sometimes happens that a denoting phrase denotes nothing.[34] In these cases it is necessary to give some interpretation to sentences containing these phrases so that these sentences are meaningful and capable of truth.

Russell reasons that denoting phrases are incomplete symbols, and as such they have to be analysed in context, since they have no meaning in isolation. A proper contextual analysis of a denoting phrase or definite description will always involve reference to the qualities of "the so-and-so" which make anything "the so-and-so." The grammatical subject of the sentence containing the phrase will be replaced by a propositional function, namely, that which defines the property that makes a thing "the so-and-so."[35]

The theory of descriptions is formal in its general structure, but it also deals with experienced entities and actual complexes.[36] This enables it to be applied to any subject matter as a neutral method of analysis, but when it deals with actual complexes its results have a claim of being objectively correct. The general use of the theory of descriptions in science is evident; its formal nature, it would seem, would make it applicable in ethics. Also, in view of the fact that the general theory of descriptions has been used by Russell in the analysis of the symbolism of science and of ordinary life, it is apparently applicable to ethical statements which are but a part of the symbolism of everyday life.

For Russell, ethical terms are incomplete symbols because they do not refer directly to any aspect of our experience.[37] This means that they can be treated by the theory of descriptions to reveal the reference of ethical statements to certain psychological states of the speaker. If a proper analysis of ethical sentences reveals them to have such factual reference, there is no reason to accept Russell's emotive-persuasive interpretation of the nature of ethics. The possibility of a science of ethics would follow within Russell's position from the demonstration that ethical sentences do have an empirical factual reference, and hence are capable of verification.

To what degree has the demonstrated possibility in Russell's philosophy of a science of ethics reconciled his position with Dewey's? Neither Dewey nor Russell holds that the function of philosophy is to set up in working order a science of ethics, or, for that matter, a science of any sort. So regardless of the actual barriers to a science of valuation which exist at the present, there is a basis established for a science of ethics within both Dewey's and Russell's positions. The specific nature of this science would vary from the one man's position to the other's, according to their disagreement over the general nature of science and of knowledge.

The conclusion, then, is the same regarding a science of ethics as it is regarding any science considered from Dewey's and Russell's positions. This is not to claim exact agreement in the proper philosophical interpretation of the foundations of the science, but agreement that such a science field exists and that valid scientific results can be expected from it. This is not much agreement when applied to scientific fields of long standing and demonstarted results; however, in the science of ethics, to have attained even such minimum agreement between Dewey and Russell is significant in view of the antithetical positions apparently held. 273 pages. $3.55. Mic 58-4837

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Abstract published by special arrangement with The Ohio State University.

PAUL CARUS: A STUDY OF THE THOUGHT AND WORK OF THE EDITOR OF THE OPEN COURT PUBLISHING COMPANY

(Publication No. 25,282)

James Francis Sheridan, Ph.D.
University of Illinois, 1957

This study opens with a description of Carus's life prior to his assumption of the position of editor of the Open Court Publishing Company, and calls attention to two factors in his early life which influenced his subsequent thought and career, the religious character of his rearing and his self-imposed exile from Germany. There follows an account of the difficulties experienced by religion and philosophy in the face of the rapid development of science in the nineteenth century. These difficulties are asserted to be the chief object of Carus's philosophic concern. Since the solution which Carus proposed for them was a philosophy called monism, an attempt is made to identify the antecedents of that view. It is arged that the sources of Carus's thought are not to be found in philosophies other than monism, so that position is described as it was put forward by Ernst Haeckel, Lloyd Morgan, Ernst Mach, and Lester F. Ward. Carus's monism is developed by comparison and contrast with the views of these other monists and is then set forth systematically. Carus's position is discussed under the three headings, ontology, methodology, and pragmatology. The first of these includes his remarks on the nature of reality and the nature of the self as a part of the real, the second exhibits his views on the nature and origin of knowledge, and the third is represented by a brief presentation of his theory of ethics and aesthetics. Evaluation of his position is deferred until after the discussion of his work as editor of the Open Court in the second chapter.

The second chapter concerns itself with Carus's work as editor of the Open Court, with his labors in the field of religion, and with his opposition to certain anti-monistic tendencies in the early twentieth century. An account is given of the aims and activities of the Open Court, and it is argued that monism, the philosophy on which the company was based, was responsible for the books it published and for the nature of most of the material which appeared in the two journals it put out, The Monist and The Open Court. A description of the books and the journals is offered in substantiation of the claim that their appearance was inspired by the monistic convictions of Carus and of the founder of the Open Court, Edward C. Hegeler. The theme of monistic influence is carried out in a discussion of Carus's work in the field of religion which included publications concerned with Buddhism, Taoism, and Christianity. This account of Carus's religious interests is concluded with a description of his advocacy of a program for securing greater agreement among various religions by calling religious parliaments to permit open discussion of their commonalities and differences. This program was inspired by the success of the Parliament of Religions which was held in Chicago in 1893. The program failed to receive effective support and that failure is noted as a sign of what Carus opposed as a revolt against reason. Other indications of that antiintellectualism include the development of relativity theory in physics, the philosophies of Bergson and James, and the work done in mathematics and logic in the late nineteenth and early twentieth centuries.

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The chapter concludes with an account of Carus's concern with World War I which he took to be another obstacle to the immediate realization of monism.

The third and last chapter presents an evaluation of Carus's thought and work. Charles S. Peirce's critique of Carus's thought is described and is followed by the writer's appraisal of the basic principles of monism. An attempt is made to evaluate Carus's standing during his life and to offer an explanation for the neglect which he has suffered since his death. It is argued that despite that neglect, the work which his convictions inspired, for example the Paul Carus lectures, has been a permanent contribution to the history of philosophy.

239 pages. $3.10. Mic 58-4838

PHYSICS

PHYSICS, GENERAL

THE VIBRATIONAL SPECTRUM OF N-METHYL FORMAMIDE

(L. C. Card No. Mic 58-899)

Donald Earl DeGraaf, Ph.D.
University of Michigan, 1957

The peptide link, -CO-NH-, is one of the important structural features of proteins. N-methyl formamide (hereafter referred to as NMF), $HCONHCH_3$, has a structure very similar to that of the protein peptide group, and thus serves as a model compound for the study of the configuration and vibrational spectrum of the peptide group. Concurrent study of N-deutero N-methyl formamide (hereafter referred to as NDNMF) leads to an explanation of the effects of N-deuteration on the spectrum.

The peptide group is expected to be planar, on the basis of the theory of resonance. A comprehensive review of the published experimental evidence concerning the configuration of trans, cis, and terminal peptide groups leads to the conclusion that in a number of crystalline trans peptides there are significant deviations from planarity. It appears that the peptide group by itself has minimum potential energy when in a planar configuration, but the requirements of crystal packing lead to a deformation of the peptide plane in some crystals.

The experimental data obtained include infrared and Raman spectra of NMF and NDNMF. Infrared spectra of NMF in the range ~320-3600 cm^{-1} were obtained on the following phases: pure liquid, 0.2 molar and 0.04 molar solutions in CCl_4, 0.03 molar solution in CS_2, and vapor. Infrared spectra of NDNMF (pure liquid and 0.2 molar solution in CCl_4) were obtained in the region ~320-3600 cm^{-1}, and a 0.04 molar solution of NDNMF in CCl_4 was observed in the range 340-700 cm^{-1}. In addition, polarized Raman spectra of liquid NMF and NDNMF were obtained in the range 225-3600 cm^{-1}.

Perkin-Elmer Model 21 and Model 112 spectrometers, variously equipped with CaF_2, NaCl, and CsBr prisms, were used to record the infrared spectra. Raman spectra were observed using a Gaertner spectrograph with a helical Toronto type mercury arc source.

The infrared spectrum of NMF in the vapor state was obtained using a heated vapor absorption cell designed and constructed for this purpose. The vapor band contours were studied in an effect to obtain some information regarding the configuration of NMF, but the evidence derived concerning the configuration is not regarded as conclusive. A trans model having a plane of symmetry was adopted as the most probable configuration of NMF.

The observed spectral bands are assigned to the normal vibrations of NMF and NDNMF on the basis both of their association and deuteration shifts, and the depolarization ratios of the Raman lines where these could be measured. Evidence favoring these assignments in contradiction to those offered by previous investigators is discussed. Assignments are also suggested for observed combination bands. 145 pages. $2.00.

DESIGN AND CONSTRUCTION OF A VACUUM-GRATING SPECTROGRAPH FOR THE INFRARED

(L. C. Card No. Mic 58-1322)

John Alva Herndon, Ph.D.
University of Tennessee, 1957

Major Professor: Alvin H. Nielsen

A new vacuum-grating spectrograph has been designed and constructed in the Department of Physics at the University of Tennessee. The instrument was designed to be as automatic as possible without restricting its versatility and resolving power. Incorporated in the instrument is a Fabry-Perot calibrating system which makes it possible to obtain measurements with an absolute accuracy of about ± 0.01 cm^{-1}.

The instrument which employs a modified Pfund type optical system is housed in a large vacuum tank and can be operated at pressures as low as 75 microns. The controls for operating both the infrared and Fabry-Perot parts of the instrument are mounted in relay racks outside the vacuum tank, and the various adjustments which must be made while the instrument is under vacuum are controlled by synchro control systems. A synchro transmitter in the relay racks is rotated by an appropriate amount and the synchro repeater in the vacuum system reproduces the rotation to make the necessary adjustment.

There are at present four gratings which may be used in the spectrograph. These gratings have rulings of 1500 lines-per-inch, 7500 lines-per-inch, 4500 lines-per-inch and 1200 lines-per-inch, and they cover the region from 8500 to 400 cm^{-1}. There are also two detectors which may be used. These are a thermopile and a PbS cell. The thermopile may be used over the entire range from 8500 to 400 cm^{-1}, and the PbS cell may be used above 3600 cm^{-1}.

The instrument has been tested and has produced data with a resolution of 0.01 cm^{-1} which is close to the theoretical resolving power of the gratings. 132 pages. $2.00.

THEORY OF ISOTHERMAL GALVANOMAGNETIC EFFECTS FOR SINGLE CRYSTALS

(L. C. Card No. Mic 58-935)

Lien Pei Kao, Ph.D.
University of Michigan, 1957

The isothermal galvanomagnetic effects bear various conventional names such as the transverse and the longitudinal magneto resistance, the Hall, the "planar Hall field," and the Corbino effect, corresponding to cases where the magnetic field is either normal or parallel to the current, or in the plane of the current and the Hall probes.

In the first part of this dissertation the isothermal galvanomagnetic effects are defined phenomenologically with the magnetic field, the electric field, and the current vectors arbitrarily oriented with respect to the crystal axes and to each other. Thus all the conventional studies cited above are included as special cases. The literature is inconsistent with regard to the parity properties of the galvanomagnetic effects as a function of the magnetic field $\underline{B}$. Some of these properties are here deduced from Onsager's relation and symmetry considerations. In particular, it is shown that the magneto resistance* is necessarily an even function of $\underline{B}$, while, contrary to convention, the Hall effect is in general neither an odd function (as is usually assumed) nor an even function of $\underline{B}$, but can be purely odd or purely even or zero under proper conditions.

These effects are then analyzed in terms of an ascending power series of the components of $\underline{B}$, whose coefficients are denoted by the "brackets." Prior to this work the crystallographic effects have never been taken into account comprehensively. An overall investigation of the effect of the 32 point groups upon the isothermal galvanomagnetic effects is attempted. A theorem is developed to deal generally with tensors of arbitrary rank under the restriction of an arbitrary N-fold axis of rotation.

The Corbino effect, which has not been previously studied in single crystals, is dealt with very briefly, and its relations with the magneto resistance and the Hall effect are established for special cases.

The brackets are then defined microscopically according to the conventional single-band model and according to a multiband model. This brings out a formal completion of the microscopic theory of the isothermal galvanomagnetic effects, developed by Jones and Zener (1934), Davis (1939), and Seitz (1950); by Sondheimer and Wilson (1947), and by Jones (1936). The multiband model includes the single band as well as the two-band and many-valley models as special cases.

A detailed discussion is presented of the conditions under which the even part of the galvanomagnetic tensor vanishes. This gives some criteria for avoiding one of the outstanding difficulties of the existing simple theories, viz., how to choose a simple microscopic model without yielding zero longitudinal magneto resistance.

104 pages. $2.00.

*For convenience, we shall refer throughout to $\rho\lambda\mu(\underline{B})$ as magneto resistance, and to $[\rho\lambda\mu(\underline{B}) - \rho\lambda\mu(\underline{B} = 0)]$ as magneto resistance change. Sometimes the latter is abbreviated by the former when no confusion is introduced.

MAGNETIC MOMENT OF THE PROTON IN UNITS OF THE BOHR MAGNETON; CYCLOTRON RESONANCE ABSORPTION BY FREE LOW-ENERGY ELECTRONS

(L. C. Card No. Mic 58-1295)

Sidney Liebes, Jr., Ph.D.
Stanford University, 1958

The nuclear magnetic resonance frequency

$$\omega_p = 2\mu_{p(oil)}H/h$$

of protons in a spherical sample of mineral oil is measured in the same magnetic field as is the cyclotron frequency $\omega_e = eH/mc$ of free low-energy electrons. The ratio of these frequencies is equal to $\mu_{p(oil)}/\mu_0$, the magnetic moment of the proton, uncorrected for diamagnetism, in units of the Bohr magneton $\mu_0 = eh/2mc$.

It is of particular interest to combine the present result with the experimental value of $\mu_e/\mu_{p(oil)}$ in order to determine μ_e/μ_0, the magnetic moment of the free electron in units of the Bohr magneton. There is a sufficiently small experimental uncertainty associated with this value for μ_e/μ_0 that a useful comparison may be made with the theoretical estimates of μ_e/μ_0 obtained by calculations through fourth order in the radiative corrections of quantum electrodynamics.

The free electrons are produced by photoelectric emission from a film of a few molecular layers of potassium deposited upon the inner surface of a highly evacuated ~1/2-cm diameter spherical bulb of Pyrex. The cyclotron frequency is observed by use of microwave power absorption techniques.

The experiment is complicated by shifts which occur in the electron cyclotron frequency as a consequence of the interaction of the electrons with inhomogeneous static electric fields such as may be produced by space charge and by charge accumulations upon the boundaries of the system within which the electrons are confined. These shifts are a function of the magnetic field intensity and are accounted for by an extrapolation procedure which requires, both for its application and for its justification, that an investigation be made of the dependence of the proton-electron frequency ratio upon the magnetic field intensity.

Classical and quantum-mechanical considerations of the theory of electron cyclotron power absorption are presented. The results of calculations pertaining to the magnetic field dependent frequency shifts are verified experimentally.

After application of all known corrections, we obtain for the magnetic moment of the proton, observed in a spherical sample of mineral oil, in units of the Bohr magneton,

$$\mu_{p(oil)}/\mu_0 = (657.462 \pm 0.003)^{-1} \quad \text{(probable error).} \quad (1)$$

Upon application of a diamagnetic shielding factor of $(3.03 \pm 0.06) \times 10^{-5}$, we obtain

$$\mu_{(free)}/\mu_0 = (657.442 \pm 0.004)^{-1} \quad \text{(probable error).} \quad (2)$$
$$= (1.521047 \pm 0.000009) \times 10^{-3}$$

Combining (1) with the average of published results,

$$\mu_e/\mu_{p(oil)} = 658.2293 \pm 0.0011, \quad (3)$$

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we obtain for the magnetic moment of the free electron in units of the Bohr magneton

$$\mu_e/\mu_o = 1.001167 \pm 0.000005 \quad \text{(experimental)}, \quad (4)$$

$$= 1 + (\alpha/2\pi) + [(1.0 \pm 1.0)(\alpha^2/\pi^2)]$$

which is to be compared with the conflicting theoretical values for the fourth-order radiative corrections:

$$\mu_e/\mu_o = 1 + (\alpha/2\pi) - 2.973(\alpha^2/\pi^2)$$

$$= 1.0011454 \quad \text{(Karplus and Kroll)}, \quad (5)$$

and

$$\mu_e/\mu_o = 1 + (\alpha/2\pi) - 0.328(\alpha^2/\pi^2)$$

$$= 1.0011596 \quad \text{(Sommerfield)}. \quad (6)$$

Assuming that the remainder of the terms of the infinite series of radiative corrections provide a relatively negligible contribution to the electron moment, the present result (4) does not support the original fourth-order calculation (5) of Karplus and Kroll, but is in reasonable agreement with the result of a very recent recalculation by Sommerfield (6). 160 pages. $2.10

RESULTS OF INVESTIGATION OF LOW-INTENSITY RECIPROCITY LAW FAILURE

(L. C. Card No. Mic 58-959)

Robert Leonard Martin, Ph.D.
University of Michigan, 1957

The physical properties of the photographic emulsion, the nature of the photographic latent image, the Mott and Gurney theory of latent-image formation, and a simple model used by Webb to calculate an effective electron trap depth are briefly described. This "single-trap-depth" model predicts a simple, isodense, low-intensity reciprocity-law-failure (rlf) curve whose slope rapidly approaches -1 with decreasing intensity of exposure. A quantitative theory of the mechanism of latent-image formation proposed by Katz (outlined in Chapter II) predicts noninteger low-intensity rlf slopes when an exponential distribution of trap depths is assumed, and therefore agrees better with experimental results. It is shown in Chapter V that for this model the limiting slope will also become -1 for sufficiently low intensities (depending on the total number of traps per grain) but the slope for an extended intermediate section is still inversely proportional to the spread in the assumed exponential distribution. This dependence of rlf slope on spread of trap depths suggests that if their distribution varies with grain size, then a relationship between grain size and rlf slope might be expected. This provides the motivation for the experiments described in Chapters III and IV.

A new type of apparatus for use with very low intensities and long times of exposure is described in detail. The principle advantages of this design were the compactness permitted by the use of slides instead of a sector wheel, the simultaneous exposure of three plates, and the flexibility possible with the automatic timing circuit which controlled the exposure program.

Pure AgBr emulsions were used for the experiments of rlf vs grain size in order to avoid difficulties arising from the correlation between iodide content and grain size. Since the characteristics of these emulsions change more rapidly with time than those of ordinary commercial emulsions, a uniform program of storage before and after exposure was employed, with test experiments to demonstrate the validity of this procedure.

The rlf slopes from the five pure AgBr emulsions, whose average grain size ranged from about .2 μ^2 to 5 μ^2, demonstrate a definite increase in slope with average grain size of emulsion used when developed with internal developer and a similar but less marked tendency with surface development. This effect was stronger when higher temperatures of storage and exposure were used. A systematic indication of more structure in the experimental curves than could be accommodated by either the "exponential-trap-depth" or "single-trap-depth" model was observed. However, this was only slightly beyond the estimated experimental error.

It is shown that a simple model assuming two discrete trap depths provides low-intensity rlf curves of considerable structure which are qualitatively similar to experimental curves. For example, they show an extended, almost straight section of noninteger slope. These curves are described in terms of the relative abundance and depths of deep and shallow traps in the grain. A method of obtaining these parameters by analysis of experimental curves is given.

Suggestions for improvement of the experimental technique and possible additional experiments suggested by the "two-trap-depth" model are offered. 153 pages. $2.05.

THERMAL CONDUCTION IN METALS BELOW 1°K

(Publication No. 25,460)

James Nicol, Ph.D.
The Ohio State University, 1952

Temperatures in the region 1°K to 4.2°K are reached by the use of liquid helium. Various methods of production of liquid helium are discussed in the dissertation and a description of the helium liquefier recently constructed in the Department of Physics and Astronomy at The Ohio State University is given. The apparatus incorporates a new type of heat interchanger[1] which is noteworthy for its simplicity of construction, compactness, and efficiency of operation. The new design appears to have an important general application where heat interchange between two gas streams having greatly different thermal capacities per unit volume is concerned.

Below 1°K, temperatures down to a few milli-degrees above absolute zero are at present obtained by adiabatic demagnetization of a paramagnetic salt. The temperatures attainable by this method are restricted by (a) the initial temperature, that of the liquid helium bath, and (b) the magnitudes of the magnetic fields available. To reach still lower temperatures, a process of cascade demagnetization has been proposed.[2] In this process a paramagnetic salt sample is cooled below bath temperature before demagnetization by being brought into thermal contact with a larger paramagnetic salt sample which has already been cooled by adiabatic demagnetization. For this process to be

successful a thermal switch must be available which will permit cooling of the smaller sample by the larger and which, after the second demagnetization, will permit the smaller sample to remain thermally isolated.

Experiment has shown that for a pure superconducting metal, the thermal conductivity in the normal state is very much greater than in the superconducting state. The ratio of the thermal conductivities may be as large as 1000:1 or larger at an appropriately low temperature. Since a superconducting metal may be changed at will from the superconducting to the normal state by the application of a moderate magnetic field, its use as a thermal switch has been proposed and demonstrated by Daunt and Heer.[3,4]

Quantitative information on the thermal conductivities of metals at low temperatures, upon which such a device may be designed is exceedingly meager, as is also the theoretical back-ground to the subject. The experimental knowledge of the thermal conductivities of metals, superconductors and non-superconductors, is reviewed. Theories of thermal conductivity are discussed, particular attention being paid to the theories of Daunt[3] and of Heisenberg.[5,6] Both of these theories concern the thermal conductivity in a superconducting metal in which, in the normal state, the thermal conduction is predominantly electronic. The two theories lead to different functions of temperature for the ratio K_s/K_n in which K_s is the thermal conductivity of the metal in the superconducting state, and K_n that in the normal state. A knowledge of the behavior of this ratio is particularly important, not only from the theoretical aspect, but also in the design of the thermal switch discussed earlier.

On the assumption that such a controllable thermal link is feasible, a detailed discussion is given of two alternative cascade demagnetization cycles and of the considerations to be borne in mind in choosing the type of paramagnetic salts for use in such a process.

For the experimental work to be described in the following paragraph a cryostat was built which consisted basically of a specimen chamber, 78 inches high and 20 mm. in diameter at its lowest section, enclosed within two Dewar vessels, each 62 inches high. During an experiment, the inner Dewar was filled with liquid helium and the outer Dewar with liquid nitrogen. By means of high speed oil diffusion and mechanical vacuum pumps, the specimen chamber and the helium vapor region could be evacuated. The effect of the latter was to reduce the temperature of the liquid helium surrounding the specimen chamber from 4.2°K to approximately 1°K. The complete cryostat assembly was mounted upon a steel frame-work. The frame-work, in turn, could be raised and lowered along the full length of a vertical steel I-beam, eleven feet in height. To permit rotation about a vertical axis, the I-beam was supported top and bottom in conical roller bearings. The magnetic fields required for the demagnetization processes were provided by two fully enclosed barrel-type electro-magnets mounted one above the other on a steel frame-work. This assembly could be rolled, on steel rails laid on the floor of the laboratory, into a position in which both magnets enclosed the specimen chamber and the Dewars. Each magnet was designed for a maximum power input of twenty kilowatts when cooled with oil under pressure. With an energising current of 100 amperes, approximately ten kilowatts, the magnetic field produced across the two inch gap between the pole-pieces was approximately eleven kilogauss.

To obtain experimental data on the thermal conductivity of a superconducting metal at temperatures lower than previous measurements, a sample of pure lead was investigated below 1°K. The lead sample was mounted between two paramagnetic salt samples which were demagnetized simultaneously to slightly different temperatures in the region of 0.1°K. Thereafter, the temperature of each sample as it warmed up slowly to the helium bath temperature, 1°K, was measured as a function of time. The thermometric parameter employed as a temperature indicator was the susceptibility of each salt, measured by an a.c. bridge method. The temperature-measuring system had a sensitivity of 0.001°K at 0.1°K. By computing the heat influx to each sample from the observed curves of temperature versus time, the heat flow between the samples by conduction through the lead strip could be calculated, and hence the thermal conductivity of superconducting lead. Observed results for this quantity covered the temperature interval from 0.129°K to 0.378°K. Selected values of the observed thermal conductivity of pure superconducting lead are given in Table 1, with, for comparison, the values predicted by the Daunt theory and the Heisenberg theory. These latter figures are based upon an extrapolation of measurements by Rademakers[7] of the normal thermal conductivity at approximately 1°K.

TABLE 1

T^0K	$K_s(D)$	$K_s(H)$	$K_s(obs)$
0.13	31×10^2	4×10^{-23}	1.2×10^2
0.22	150×10^2	4×10^{-11}	2.4×10^2
0.29	350×10^2	7×10^{-6}	3.7×10^2

Legend:
$K_s(D)$ Calculated value of the thermal conductivity of pure superconducting lead, according to the theory of Daunt, (erg units).
$K_s(H)$ Calculated value of the thermal conductivity of pure superconducting lead, according to the theory of Heisenberg, (erg units).
$K_s(obs)$ Experimental results for the thermal conductivity of pure lead in the superconducting state, (erg units).

The experimental results are lower than those predicted by Daunt, but considerably higher than those predicted by Heisenberg. Two alternative explanations are possible. According to the first, the Heisenberg theory is correct and the electron thermal conductivity observed experimentally is a lattice conductivity. This has been estimated according to a method proposed by Daunt. The agreement between this calculated lattice thermal conductivity and the total observed thermal conductivity is surprisingly good, as is shown in Table 2.

In view of the difficulties of measurement involved and the assumptions made, the agreement should not be considered as other than one of order of magnitude.

The second alternative is that our results are in agreement with the Daunt theory, but in this event the thermal conductivity of our specimen at 1°K would be some 50 times smaller than that of Rademakers. Although this is

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TABLE 2

$T^{\circ}K$	K_{s1}	K_s(obs)
0.2	160	200
0.3	540	420
0.4	1300	950

Legend: K_{s1} Estimated value of the lattice thermal conductivity in superconducting lead. The estimate is based upon the method of calculation suggested by Daunt, (erg units).

K_s(obs) Experimental results for the total thermal conductivity of superconducting lead, (erg units).

possible, it is unlikely in view of the purity of the sample. The point must remain at issue until more accurate measurements in the temperature ranges $0.1^{\circ}K$ to $0.5^{\circ}K$ and $1^{\circ}K$ to $4.2^{\circ}K$ can be made.

Experiments on cascade demagnetization have been carried out successfully, but the extremely low temperatures hoped for initially have not yet been reached because of minor experimental troubles. When these are overcome, the information gained on the thermal conductivity of lead, will, it is hoped, permit a successful double demagnetization and the attainment of a new and lower temperature range than that yet investigated.

In an Appendix there has been compiled a list of references to measures of the thermal conductivities of various metals and alloys at low temperatures.

165 pages. $2.20. Mic 58-4839

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Abstract published by special arrangement with The Ohio State University.

THE INFRARED AND RAMAN SPECTRA OF SINGLE CRYSTALS OF ORDINARY ICE

(L. C. Card No. Mic 58-1444)

Nathan Ockman, Ph.D.
University of Michigan, 1957

The principal purpose of this investigation is to obtain the polarized infrared and Raman spectra of single crystals of ordinary ice and to relate these results to several proposed crystal structures. A secondary aim is to attempt to explain the observed bands in terms of the internal and intermolecular vibrations of the water molecules comprising the ice lattice. This study is divided into the following four parts:

1. Development of the techniques for growing suitable single crystals of ice.

2. Determination of the polarized infrared transmission and reflection spectra and the polarized Raman spectrum of ice crystals.

3. Calculation of the vibrational dichroism of the intramolecular modes for seven proposed structures.

4a. Comparison of the observed dichroism of the intramolecular bands with the calculated dichroism for the above structures.

b. Assignment of the observed bands.

The ice crystals were grown by slowly lowering a polycrystalline specimen through a furnace which maintains a stationary solid-liquid interface across the sample. Three crystals, 1.25 cm in diameter and 15 cm long, were grown for the Raman studies and several rectangular crystals, 2.5 cm by 5 cm, and varying in thickness from 0.01 cm to 1 cm, were grown for the infrared studies.

The polarized infrared transmission and reflection spectra of single crystals were studied from 3900 cm^{-1} to 11250 cm^{-1} and from 440 cm^{-1} to 4400 cm^{-1}, respectively, at temperatures of $-30^{\circ}C$ and $-175^{\circ}C$. The incident radiation was generally polarized parallel and perpendicular to the projection of the optic axis on the crystal face. Unpolarized infrared transmission spectra of very thin ice films were also studied between 370 cm^{-1} and 3700 cm^{-1} at the aforementioned temperatures. Of the 25 bands appearing in the infrared spectrum, 13 have not been previously reported. Only one low frequency band is dichroic. The Raman spectrum was obtained at temperatures of $-18^{\circ}C$ and $-150^{\circ}C$ with the incident radiation polarized parallel and perpendicular to the optic axis. None of the intramolecular Raman bands are completely polarized.

On the basis of the oriented gas approximation, the dichroism of the intramolecular bands was calculated for the previously proposed models of Bernal and Fowler, Owston, Pauling and Rundle. In addition, two modifications of the Bernal and Fowler and one modification of the Pauling model were also considered. Only the Owston model predicts a considerable infrared dichroism. All of the models predict incomplete polarization of the intramolecular Raman bands.

A comparison of the calculated dichroism with that observed can only eliminate the Owston model. However, the Pauling disordered model appears to be the most likely structure for ice since it is the only model which is in agreement with all of the reliable experimental data on ice.

With regard to the assignment of the bands, only those arising from the molecular fundamentals and those combinations of the molecular fundamentals which are observed

in the vapor spectrum can be identified with any certainty. With the aid of heavy ice data obtained by other workers and with the present data on the effect of temperature on frequencies, an attempt is made to classify the intermolecular modes into rotatory and translatory vibrations. By correlating the solid spectrum with that of the liquid and vapor, tentative assignments are proposed for the remainder of the overtone and combination frequencies.

181 pages. $2.40.

MEASUREMENT OF ABSOLUTE TEMPERATURE IN THE RANGE 1.0°K. TO 0.1°K.

(L. C. Card No. Mic 58-569)

John William Snider, Ph.D.
The Ohio State University, 1957

A new technique for the measurement of absolute temperature in the region below 1°K. was developed. A paramagnetic substance, in this case ferric acetylacetonate, suitable for use as a secondary thermometer is demagnetized adiabatically while in thermal contact with cerium magnesium nitrate which is known to follow Curie's Law to 0.01°K. The secondary thermometer is then calibrated against the temperature of the cerium salt, calculated from the measured susceptibility, during the warm-up period following demagnetization.

The susceptibility of several paramagnetic substances was investigated experimentally by placing each of them in thermal contact with the ferric acetylacetonate, which was used, through the adiabatic demagnetization process, as a refrigerant and, with the above calibration, as a thermometer.

Graphical representations of the susceptibility as a function of absolute temperature are presented for the following substances in the temperature range 3.5°K to 0.3°K: ferric acetylacetonate, synthetic ruby, manganous potassium sulfate, common brick, chromic acetylacetonate.

From these susceptibility curves, the relationship between the magnetic temperature and absolute temperature was determined for each of these substances, and is presented graphically.

As a demonstration of the applicability of this technique, the zero field entropy was determined as a function of the absolute temperature for the synthetic ruby and for a powder sphere of ferric acetylacetonate, the absolute temperature being derived from the magnetic temperature by use of the T* vs. T curves described above.

The results of these measurements, for temperatures above 0.6°K, are as follows:

synthetic ruby $\quad 1n4\text{-}S/R = \frac{0.125}{T^2} - .059$

ferric acetylacetonate $\quad 1n6\text{-}S/R = \frac{0.297}{T^2} - .182$

The results are briefly analyzed in terms of the electric and magnetic interactions which may cause deviations from Curie's Law, and the entropy measurements for the ferric acetylacetonate are compared with those made by Pillinger on the same substance. 119 pages. $2.00.

AN INVESTIGATION IN THE ZONE THEORY OF THE ENERGY OF ELECTRONS IN METALS

(L. C. Card No. Mic 58-998)

George Baugh Spence, Ph.D.
University of Michigan, 1957

This work is a theoretical investigation of certain general problems which occur in using the zone theory of the electron energy bands to determine the phase boundaries of those alloys agreeing with the Hume-Rothery electron concentration rules. There are four main objectives of the work.

The first objective pertains to the possible existence of an energy gap at an electron concentration corresponding to the volume of the zone, often called the Brillouin zone, of an alloy structure. It is shown that an energy gap cannot exist for some zones because of what is here called a shape degeneracy. Shape degeneracies exist in those zones which cannot be constructed from an integral number of mappings of the unit cell of the reciprocal lattice of the alloy structure. A "mapping" of the unit cell is the division of the unit cell into sections, if necessary, and the translation of each section by a reciprocal lattice vector. Shape degeneracies exist, for example, in the zones of the γ-brass and β-manganese structures.

The second objective is to obtain qualitative information about the energy surfaces in large zones by the correct use of the nearly-free-electron approximation. The main result here is that the electron energy surfaces in some large zones, for example, the γ-brass zone, are not qualitatively similar to the simple surfaces in the first zone of the conduction electrons of the noble metals.

Because of the existence of shape degeneracies and the necessarily complicated nature of the energy surfaces in certain large zones, the volume of these zones cannot, as has been assumed up to now, be used to predict precisely the location of energy gaps or low dips in the density of states.

The third objective is to solve accurately two simple numerical problems. The two- and three-dimensional problems are constructed from two one-dimensional Schrödinger equations with potentials of one and two cosine terms, respectively. The two-dimensional energy contours illustrate some of the complexities of the electron energies which occur in large zones. Accurate density-of-states functions N(E) for the three-dimensional problems illustrate the type of structure which can occur in these functions and also show the effect on these functions of Brillouin zone planes, corresponding to weak cosine terms, which cut inside the large zone.

The fourth objective is to gain a better qualitative interpretation of the Hume-Rothery rules. The usual approximation is made that the change in the thermodynamic free energy with electron concentration n is due only to the change in the total conduction electron energy U(n). It is shown that for typical phase boundary problems $U_1(n)$ for phase one, instead of increasing realtive to $U_2(n)$ as the zone is filled beyond the peak in $N_1(E)$, continues to decrease relative to $U_2(n)$ until that energy is reached at which the total numbers of electrons are equal in the two phases. This shows that the positions of the phase boundaries cannot be accurately predicted theoretically from the electron concentration corresponding to the peak in the density of states.

Other results of this investigation suggest that N(E) and U(n) are determined primarily by the geometrical shape of the zone and hence should be about the same for different alloys with the same structure. It follows from this that the same phases of the different alloy systems should occur at the same electron concentrations.

121 pages. $2.00.

FAST TIMING APPLIED TO THE TAU-MESON DECAY

(Publication No. 17,581)

Robert K. Stitt, Ph.D.
University of Utah, 1956

Supervisor: J. W. Keuffel

A single large liquid scintillation detector was used to measure the mean life of the τ^+-meson, using cosmic rays as a source. Selection was made by the well known decay scheme of the τ^+-meson, $\tau^+ \rightarrow \pi^+ + \pi^+ + \pi^-$ + 75 Mev. Each π^+ subsequently decays as $\pi^+ \rightarrow \mu^+ \rightarrow e^+$. The π^- undergoes nuclear absorption producing a star. Identification was made by demanding that the complete process take place in the detector and that the pulses from both e^+ secondaries be detected. These were identified as the decay electrons from μ^+-mesons by plotting their mean life. It was found to agree within the statistical error with the known 2.2 μsec mean life of μ^+-mesons.

A novel fast pulse-forming circuit was designed and built to make it possible to observe with a chronotron the delay between the pulses formed in the detector when the τ stopped and when it decayed.

Twenty-two events were observed that were identified as τ^+-mesons and for which an accurate measurement of the delay could be made. A statistical treatment of these events gave a value of $T(\tau^+) = (9.7 \pm 3.1)m\mu$sec. This agrees within the statistical errors with the latest value given by Fitch, $T(\tau^+) = (12.3 \,^{+\,1.4}_{-\,2.0})$ mμsec.

The decay times of several second solutes were measured relative to the decay time of a standard solution of 5 g/1 terphenyl in toluene. The second solutes used were POPOP, αNPO and diphenyl-hexatriene. These were used at a concentration of .05 g/1 in a solution of 5 g/1 of terphenyl in toluene. These measurements were made with a detector that consisted of 9 cm diameter bulb viewed by a single RCA type 1P21 photomultiplier. The decay times measured were: 6.3 musec for POPOP, 3.8 mμsec for αNPO, and 9.0 mμsec for diphenyl-hexatriene.

82 pages. $2.00. Mic 58-4840

FINE STRUCTURE OF DEUTERIUM BY A RADIO-FREQUENCY OPTICAL METHOD

(L. C. Card No. Mic 58-1309)

Lee Roy Wilcox, Ph.D.
Stanford University, 1958

The energy difference $\delta_D(n = 3)$ between $3^2S_{1/2}$ and $3^2P_{1/2}$ states of deuterium is determined by an rf-optical method. Preliminary measurements of n = 4 fine structure are reported and a technique enabling measurement of electrostatic fields within a low-pressure discharge is evolved. Quantum-mechanical calculations required for the experiment are developed from the density matrix formalism; the similarity of our problem to those arising in the theory of spin resonance in bulk material is stressed and a new treatment of the Bloch-Siegert problem involving a continued fraction expression is developed.

Our experimental method involves optical excitation of deuterium by electron bombardment. In consequence of differing radiative decay rates, fine structure states are unequally populated. Rf-induced transitions between fine structure states reduce the population imbalance, altering the strength and character of the deexcitation radiation. A photomultiplier serves to detect small changes in the intensity of the hydrogen red line (λ = 6563 A).

Assuming a well justified formula for fine structure, doublet splitting, the level shift $\delta_D(n = 3)$ for deuterium is 315.23 Mc/sec (limit of error 1 Mc/sec). The limit of error is three times the Stark effect correction applied to our data. Our result corroborates a recent computation of Bethe's "average excitation potentials" for the n = 3 state by J. M. Harriman. 131 pages. $2.00.

Supported in part by the joint program of the Office of Naval Research and the United States Atomic Energy Commission.

PHYSICS, ELECTRONICS & ELECTRICITY

ELECTRON TRAJECTORIES IN THE BACKWARD-WAVE OSCILLATOR

(L. C. Card No. Mic 58-1287)

James Walter Gewartowski, Ph.D.
Stanford University, 1958

Results are presented of an experimental study of the spent beam of a backward-wave oscillator. The instantaneous velocity and current of the spent beam are measured using a velocity analyser built onto the collector of a scaled 80-Mc backward-wave oscillator.

The tube employs a sheet beam and interdigital line, twelve feet long. It is designed to be representative of large-space-charge tubes.

The measured trajectories of the spent beam are examined to deduce the mechanism of interaction between the beam and the circuit along the whole length of the tube. It is found that the level of oscillation is determined by nonlinear effects in the convection current.

Finally, the mechanism of r-f output efficiency saturation at high beam currents is found to be caused by electrons which fall back in phase from a retarding to an accelerating circuit field. 61 pages. $2.00.

PERIODIC ELECTROSTATIC FOCUSING OF A HOLLOW ELECTRON BEAM

(L. C. Card No. Mic 58-1292)

Curtis Carl Johnson, Ph.D.
Stanford University, 1958

A method of focusing a long hollow electron beam is described in which beam space-charge fields are balanced against radial electric fields and periodic electric fields. There is no magnetic field associated with this focusing method. Elimination of the usual large axial magnetic-field requirement of confined flow focusing allows the tube system employing the electrostatically focused hollow beam to be lighter in weight, more compact, and to enjoy an enhancement of overall efficiency.

A physical description of the focusing mechanism is given, followed by a mathematical treatment which yields conditions for stable beam flow. Expressions are derived for electrode voltages required to focus a given hollow beam, as well as for velocity variation and beam deflection. A comparison of beam stiffness is made with a conventional confined flow beam. Beam stability is investigated under various overfocusing conditions and imperfect entrance conditions. Finally, this focusing method is compared with other purely electrostatic methods.

An experimental program was carried out which demonstrated the usefulness of this type of focusing. Results indicate that good beam definition and transmission coefficients can be obtained with some insensitivity to entrance conditions. A traveling-wave amplifier tube was designed to illustrate the potentialities of this focusing method in the UHF region. 99 pages. $2.00.

SOME INVESTIGATIONS OF SECONDARY ELECTRON EMISSION

(L. C. Card No. Mic 58-1127)

Robert Glen Lye, Ph.D.
University of Minnesota, 1957

Measurements have been made of the secondary electron emission from single-crystals of magnesium oxide. Many of the factors which confused similar studies in the past have been brought under experimental control by means of the techniques developed here. It is concluded that the maximum yield from vacuum-cleaved, uncolored, nominally pure crystals of MgO is 25 ± 7 per cent at a primary electron energy near 1200 ev. The yield from vacuum-cleaved crystals is influenced weakly, at most, by color centers introduced by additive coloration with Mg or O_2 in densities less than $10^{18}/cm^3$.

The theory of secondary emission has been studied from a phenomenological point of view similar to that of Salow[1] and of Bruining,[2] but which includes results of recent measurements by Young of the range-energy relation[3] and of the energy dissipation[4] of electron beams in thin solid films. The reduced yield curves so obtained agree with experimental data appreciably better than do the comparable curves of the above authors. The discrepancies which remain are attributed more to inaccurate knowledge of the energy dissipation of the primary beam than to errors in the basic assumptions of the simple theory.

An attempt has been made to determine from theoretical considerations the behavior of the primary beam while penetrating a solid target by using an approach suggested by Bethe, Rose, and Smith.[5] The investigation was successful in that it permitted predicting a range-energy relation for the primary beam which is in qualitative agreement with the measurements of Lane and Zaffarano[6] and of Young.[3] The application to secondary emission was less successful because of mathematical difficulties which prohibited obtaining a sufficiently precise determination of the spatial distribution for the energy dissipation of the primary beam. An approximate relation has been obtained, however, for the yield curve of MgO. Although its agreement with experiment is not considered satisfactory it appears sufficiently good to suggest that the approach is worthy of further consideration. 95 pages. $2.00.

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MICROWAVE ABSORPTION STUDIES OF ACETONE, CHLOROFORM, AND HYDROGEN CYANIDE VAPORS

(Publication No. 25,478)

Thomas Levi Weatherly, Ph.D.
The Ohio State University, 1951

The microwave region of the electromagnetic spectrum at present extends in frequency from 500 mc./sec. to 200,000 mc./sec. Spectral lines which occur at these frequencies are produced by transitions between energy levels that are very closely spaced. Microwave spectroscopy affords a means of measuring these small separations of energy levels, of testing the theories which account for them, and of determining the molecular and atomic constants involved. The present work is concerned with the microwave spectrum of acetone, chloroform, and hydrogen cyanide.

EXPERIMENTAL TECHNIQUE

The Stark modulated spectrograph used in these investigations consists of a klystron source of microwave radiation, wave guide absorption cell, crystal detector, amplifier, and recorder. The spectral line is modulated by producing an electric field in the absorption cell which is

switched on and off at 6,000 cycles/sec. The spectral line is therefore split into a number of weaker components 6,000 times per second, and thus the signal reaching the detector varies at this frequency. This signal is amplified by a narrow band amplifier tuned to 6,000 cycles/sec., rectified, and applied to the recorder.

Frequencies are measured by applying the unknown frequency, a standard microwave frequency, and a 30 mc./sec. signal to a crystal mixer and determining the beat frequencies with a calibrated receiver.

ACETONE

Four strong spectral lines of acetone have been found in the frequency region 18,000 to 30,000 mc./sec. An attempt to identify these lines as transitions between the rotational levels of an asymmetric top molecule has met with no success. The predicted spectrum contains a great many lines in the region observed, and, since the geometric structure and interatomic distances of acetone are not very well known,[1,2] the line frequencies cannot be predicted with certainty. For this reason it is impossible at present to identify the observed lines listed below:

26,661.5 mc./sec.
28,340.0 mc./sec.
28,622.3 mc./sec.
30,070 mc./sec.

CHLOROFORM

A spectral line of chloroform at 26,417 mc./sec. has been reported by Smith and Unterberger.[3] The chloroform molecule is a symmetric top, and its moment of inertia calculated from electron diffraction data[1] is

$$I_B = 258.0 \pm 6.0 \times 10^{-40} \text{ gm cm}^2 .$$

Using this valve of I_B the observed line can be identified as the transition between the rotational levels J = 3 and J = 4. The line found by Smith and Unterberger was observed to have a width of 21 mc./sec. at a pressure of 10^{-1} mm of Hg. From the frequency of the center of this line these observers computed the moment of inertia,

$$I_B = 254.1 \pm 0.1 \times 10^{-40} \text{ gm cm}^2 .$$

The present observations were made at 10^{-3} mm. of Hg in order to reduce the line width and obtain a more exact value of I_B. The observed line was 4 mc./sec. wide centered at 26,416.6 mc./sec. This frequency corresponds to a moment of inertia,

$$I_B = 254.073 \pm 0.025 \times 10^{-40} \text{ gm cm}^2 .$$

The 4 mc. width is probably the result of hyperfine structure due to nuclear quadrupole interactions. The low intensity of the line prohibits resolution of this structure.

HYDROGEN CYANIDE

Investigation of the spectrum of hydrogen cyanide in the frequency region 16,000 to 36,000 mc./sec. by Shulman and Townes[4] has revealed a new type of spectral line for this linear triatomic molecule. This line has been attributed to transitions between levels split by ℓ-type doubling as predicted by the theory of Nielsen and Shaffer.[5,6] Further investigations of this type of transition in the course of the present work has resulted in the observation of three such spectral lines for HCN and three for DCN.

The theory of ℓ-type doubling has been applied to linear XYZ molecules. A linear triatomic molecule is capable of a twofold degenerate perpendicular vibration. When this mode of vibration is excited, the molecule may possess internal angular momentum about the molecular axis. If the molecule rotates, this internal angular momentum due to vibration is coupled with the rotation of the molecular framework through the action of Coriolis forces. As a result, each rotational energy level is split into two levels. The separation of these levels is given by Nielsen's formula,[6]

$$\Delta\nu = q\, J(J+1), \qquad (1)$$

where

$$q = 2c\,\frac{B_e^2}{\omega_2}\left[1 + 4\sum_{s'}(\zeta^{x}_{2s'})^2\,\frac{\lambda}{\lambda_{s'} - \lambda_2}\right]. \qquad (2)$$

In the expression for q, B_e is the equilibrium rotational constant; ω_2 is the degenerate vibration frequency; the $\zeta^{x}_{2s'}$ are Coriolis coupling coefficients; and $\lambda_{s'} = 4\pi^2 c^2 \omega_{s'}^2$, where the $\omega_{s'}$ are the parallel vibration frequencies. The observed lines are the result of direct transitions between these two levels without any change in the rotational quantum number J. The line frequencies are predicted by equation (1). The observed line frequencies, measured q values, and calculated q values are given in Table I.

TABLE I

ℓ-Type Doubling in HCN and DCN

Rotational Quantum Number J	Observed Line Frequency $\Delta\nu$ mc./sec.	$q = \frac{\Delta\nu}{J(J+1)}$ mc./sec.	Δq
	HCN		
9	20,181.39 ± 0.15	224.238 ± 0.0015	0.053
10	24,660.40 ± 0.10	224.185 ± 0.0010	0.055
11	29,585.12 ± 0.20	224.130 ± 0.0020	
	Calculated q = 226.2 mc./sec.		
	DCN		
10	20,454.58 ± 0.15	185.951 ± 0.0015	0.048
11	24,539.20 ± 0.10	185.903 ± 0.0010	0.053
12	28,992.55 ± 0.20	185.850 ± 0.0020	
	Calculated q = 183.6 mc./sec.		

In the calculation of q one can expect accuracy to within about 2 per cent. The observed q values for both molecules are therefore in agreement with those calculated theoretically. The measured q values in Table I show a slight decrease with increasing J which is not predicted by equation (2). This phenomenon is discussed and is explained qualitatively as an effect of centrifugal stretching on the moment of inertia I_B appearing in equation (2).

The dissertation is concluded with brief discussions of the Stark effect and hyperfine structure for spectral lines produced by pure ℓ-type doubling transitions.

83 pages. $2.00. Mic 58-4841

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Abstract published by special arrangement with The Ohio State University.

PHYSICS, METEOROLOGY

AN EVALUATION OF SOME TECHNIQUES IN AGROMETEOROLOGY (METHODS RELATING TO PROBLEMS IN CULTIVATED PLANTS)

(L. C. Card No. Mic 58-836)

Jen-Yu Wang, Ph.D.
The University of Wisconsin, 1958

Supervisor: Associate Professor Verner E. Suomi

Research in agricultural meteorology requires that comprehensive records of crop data and environmental data be available. This is rarely the case in actual practice. Schemes are presented for evaluation of ordinary available crop data and meteorological data so that parameters more directly applicable to these studies can be obtained. In some cases no direct data, such as soil temperature are available. Methods of estimation are presented. For example, useful soil temperature estimation can be obtained from air temperature data. The last section illustrates tests of these schemes.

Points of emphasis of the thesis are:

1. Crop "phases" are the key to the quantitative evaluation of crop data, but use of these phases in the development of the plant depends on establishment of precise indicators of dates at beginning and termination of the phase. Criteria for the investigation of the "Sharpness of phases" are included.

2. Ideal and minimum requirements for crop data in terms of phenological events and indicators are presented. Examples are also given.

3. Methods for the modification of crop data have been established so that factors other than environmental factors can be eliminated.

4. The validity of the heat unit system is discussed. Suggestions and techniques are introduced for a new system.

5. In many cases, specific environmental data is not available. Methods are established for estimating several important agrometeorological elements, such as soil temperature, and the normality of occurrence of critical temperatures.

6. In order to simplify the complex environmental data, various single and multiple parameters have been developed. Examples of these are the evaluation of interdiurnal temperature difference, energy degree units, relative minimum precipitation and the accumulation of significant elements or events.

7. The crop rainy day is defined and its criteria determined. This is to be more effective than the definition of rainy day.

8. "Sorters" or sorting methods have been initiated and designed by the writer. The fundamental concept was borrowed from Azzi's experiments on the critical period of crops. This device is the first approximation to the quantitative interpretation of the response of crops to environmental factors. The yield of sweet corn grown in Rosendale, Wisconsin has been tested by this sorting method.

9. A parameter which expresses the accumulated rainfall for the driest interval, or the accumulated temperature for the coolest interval, or the accumulated sunshine for the cloudiest (or clearest) interval, etc., each for a particular growing season has been found to be closely related to crop events. Examples are given.

178 pages. $2.35.

PHYSICS, NUCLEAR

THE ELASTIC SCATTERING OF 40 MEV PROTONS FROM ISOTOPES OF Fe, Ni, AND Cu

(L. C. Card No. Mic 58-1109)

Morton Kremen Brussel, Ph.D.
University of Minnesota, 1957

The thesis, "Elastic Scattering of 40 MEV Protons from Isotopes of Fe, Ni, and Cu," concerns measurements made with the University of Minnesota Linear Accelerator to determine the nature of the apparent potential of nuclei presented to bombarding proton projectiles.

Angular distributions were obtained of the scattered protons from laboratory angles 7.5^{0} to 110^{0}. The targets employed were Fe^{54}, Fe^{56}, Ni^{58}, Ni^{60}, and Cu^{65}. Definite maxima and minima were observed in the cross sections determined from the data, and distinct differences in the features of the angular distributions from element to element were noted.

The angular distributions obtained are discussed in terms of the optical model of nuclei, whereby the nucleus is represented by a complex potential well. The relevance to the experimental data of the parameters employed by this nuclear model is discussed. The present results are compared with similar measurements made with other proton energies. Shell effect indications in the scattering are noted.

161 pages. $2.15.

A TIME-OF-FLIGHT SPECTROMETER FOR MEDIUM HIGH ENERGY NEUTRONS, AND A STUDY OF THE $O^{16}(d,n)F^{17}$ REACTION

(L. C. Card No. Mic 58-922)

Roger Grismore, Ph.D.
University of Michigan, 1957

During the past few years neutron scattering experiments have become an increasingly important tool for the investigation of the properties of nuclei. However, there has been a need for better means of measuring neutron energy spectra than have been available, particularly in the Mev region.

The objectives of the present investigation were to develop a high resolution time-of-flight neutron spectrometer for the 4 to 20 Mev range, and to test it by measuring the little-studied $O^{16}(d,n)F^{17}$ neutron spectrum. The F^{17} energy levels determinable from the spectrum are of interest since this nucleus is represented as a doubly closed shell core plus one proton. The location of the $D_{3/2}$ + level, which the $O^{16}(p,p)$ elastic scattering studies of Laubenstein and Laubenstein and of Sempert, Schneider, and Martin left in dispute, is particularly important because it yields the spin-orbit coupling energy in the 1d shell.

The time-of-flight spectrometer built in the investigation makes use of the natural bunching of the 7.8 Mev deuterons in the University of Michigan cyclotron beam to provide short bursts of neutrons for timing. A high voltage pulsing system deflects a deuteron burst onto the neutron-producing target every millisecond. Neutrons are collected at the end of the 5.35 m. flight path by a liquid scintillation counter. The elapsed time is measured by an improved version of the chronotron capable of a precision of $\pm$ 3 x 10^{-10} sec. Design factors for the various elements of the system are discussed.

The spectrometer was calibrated and roughly tested with a thick beryllium target. Spectra were then measured for the $O^{16}(d,n)F^{17}$ reaction using thin lead dioxide targets. The spectra were observed at a laboratory angle of 25° in the neutron energy ranges from 7.5 to 1.77 Mev and from 0.76 to 0.38 Mev, corresponding to excitations of 0 to 3.81 Mev and 4.64 to 4.93 Mev in F^{17}.

Neutron groups were found corresponding to all previously discovered F^{17} states within the given ranges, and also to the states of N^{13}, evidently as a result of carbon impurities in the targets. There was no positive evidence of new levels. Reaction Q-values of -4.66 $\pm$ 0.06 Mev, -6.37 $\pm$ 0.07 Mev, and -4.03 $\pm$ 0.05 Mev, respectively, were measured for the (d,n) processes leading to the excited states F^{17}_2, F^{17}_5, and $N^{13}_{2,3}$ (unresolved). Only the F^{17}_5 determination is absolute. The two fluorine values are believed to be the first reported for these states by the (d,n) reaction. They agree reasonably well with those measured by $O^{16}(p,p)$ elastic scattering.

The time resolution of the spectrometer is largely determined by the duration of the deuteron bursts from the cyclotron which are about 4 mμsec. in half-width for high cyclotron "dee" voltages. The corresponding neutron energy resolution is 1.5 per cent at 0.5 Mev and 9.5 per cent at 20 Mev. (Counter size effects and deuteron energy spread and energy loss in the target are neglected in these values.) The counting rate is sufficient to allow improvement of these resolutions by a factor of two or three through extending the flight path.

The experimental results indicate that the natural widths of all the neutron groups are somewhat less than those observed, the latter being governed by spectrometer resolution and target thickness. This is in agreement with previous results except for the F^{17}_5 state, which was assigned large level widths in the $O^{16}(p,p)$ scattering experiments. The suggestion is made that possibly the F^{17}_5 resonance has been incorrectly interpreted in the latter experiments, and that the $D_{3/2}$ + level of F^{17} may be found slightly above an excitation of 5 Mev. 153 pages. $2.05.

MEASUREMENT OF THE H_2-D MASS DIFFERENCE BY MEANS OF THE DECELERATING CYCLOTRON

(L. C. Card No. Mic 58-1293)

Hugh Freeborn Johnston, Ph.D.
Stanford University, 1958

The orbital frequency of an ion, moving in a magnetic field H, is given by

$$\nu_R = eH/2\pi mc .$$

Hence, the mass ratio of two species of ion can be obtained from the ratio of their orbital frequencies measured in the same magnetic field. Any device which accurately makes such a measurement is a high precision mass spectrometer.

The decelerating cyclotron of Block and Jeffries[1] is such a device and the purpose of this research has been to use it as a high precision mass spectrometer. By operating the cyclotron at the 9th and 11th multiples of the orbital frequency, it was possible to reduce the total relative width of the resonances to about 1 part in 5000.

Data were obtained by maintaining the magnetic field H constant while alternately sweeping the dee voltage frequency through the resonances of each species of ion. Resonance was detected by means of a current probe located inside one of the dees at about 1/3 of the initial radius.

There does not exist at present an exact theory to predict the resonance line shape; however, since the resonance line shapes for two members of a closely-spaced mass doublet can be expected to be nearly equal, their mass ratio can be obtained with an accuracy far greater than indicated by the line width, from the inverse frequency ratio of corresponding points on the two observed resonance curves. Indeed, this accuracy has been found, in the work described here, to be comparable to that of the most elaborate other methods.

In order to test the equality of the line shapes for the two species, four corresponding points on the resonance curves were used. The consistency of the values of

$$\Delta m = m(H_2) - m(D)$$

obtained for these four points supports the fact that the resonance line shapes for the two species are indeed very nearly equal. On the basis of this evidence and combining data of a great number of runs, the final result has been found to be

$$\Delta m = 1550 \pm 2\ \mu MU .$$

63 pages. $2.00.

1. F. Bloch and C. D. Jeffries, Phys. Rev. 80, 305 (1950)

PROTON-PROTON COLLISIONS AT 6.2 BEV

(L. C. Card No. Mic 58-1085)

Robert Michael Kalbach, Ph.D.
University of Washington, 1957

6.2 Bev proton-proton collisions are examined using nuclear photographic emulsions. Multiple scattering, grain density, and angular measurements are employed to identify the various final states.

The angular distribution of elastically scattered protons together with the elastic and inelastic cross sections are measured to permit the formulation of a simple model of the proton at this energy.

Analysis of the secondary tracks from inelastic collisions yields angular distributions and momentum spectra for the emitted protons and pions, as well as the cross sections for inelastic events with two, four, and six charged secondaries.

Results of this analysis of inelastic scattering are in marked disagreement with the Fermi statistical theory of nucleon-nucleon collisions. Effects are discussed which would account, qualitatively, for this discrepancy.

115 pages. $2.00.

A STUDY OF CHARGED HYPERONS AND NEGATIVE K-MESONS

(L. C. Card No. Mic 58-813)

Swami Sitarama Madabhushi, Ph.D.
The University of Wisconsin, 1958

Supervisor: Professor W. F. Fry

An analysis of 1001 K^- stars observed in nuclear emulsions, which were exposed to momentum analyzed negative channels at the Berkeley Bevatron is presented. A systematic following of all tracks from these stars resulted in the observation of 319 charged π mesons, 46 hyperfragments and 158 charged Σ hyperons. There were 26 $\Sigma^+ \rightarrow P + \pi^0$ decays at rest; 20 $\Sigma^+ \rightarrow \pi^+ + N$ decays at rest; 14 $\Sigma^+ \rightarrow P + \pi^0$ decays in flight; 26 $\Sigma^+ \rightarrow \pi + N$ decays in flight; 50 Σ^- stars; and 22 Σ^- zero pronged stars with one or more Auger electrons. From the $\Sigma^+ \rightarrow P + \pi^0$ decays at rest the mass of the Σ^+ hyperon was determined to be $2327.2 \pm 0.8\ m_e$. Three collinear events which are examples of the following reactions

$$K^- + P \rightarrow \Sigma^+ + \pi^-$$
$$K^- + P \rightarrow \Sigma^- + \pi^+$$

were observed, and from an analysis of these events the masses of the K^--meson and the Σ^- hyperon were found to be $965.5 \pm 1.5\ m_e$ and $2343.3 \pm 2.0\ m_e$, respectively. The branching ratio for the Σ^+ hyperon was found to be

$$R = \frac{\Sigma^+ \rightarrow P + \pi^0}{\Sigma^+ \rightarrow N + \pi^+} = 1.18 \pm 0.32 .$$

The scattering measurements on Σ^+ and Σ^- hyperons that came to rest in the emulsion, did not indicate any conclusive evidence for a Σ bound state. The best single lifetimes for the Σ^+ and Σ^- hyperons were found to be $0.96 \begin{smallmatrix}+0.37\\-0.21\end{smallmatrix} \times 10^{-10}$ sec and $2.5 \pm 0.8 \times 10^{-10}$ sec, respectively. The composite lifetime for $\Sigma^\pm \rightarrow \pi^\pm$ decays in flight was found to be $0.32 \begin{smallmatrix}+0.11\\-0.07\end{smallmatrix} \times 10^{-10}$ sec. $\theta_{\Sigma\pi}$, the angle between the direction of the π-meson from the Σ in rest system of the Σ, and the initial direction of motion of the Σ, was measured for 85 Σ decays. Of these 50 events have $|\cos \theta_{\Sigma\pi}| > 0.5$ and 53 events have $\theta_{\Sigma\pi} > 90^0$. This sample of data suggests, but does not prove that the spin of the Σ is greater than $\frac{1}{2}$ and that there is parity doubling for each Σ. Information concerning the energy distribution of Σ hyperons from K^- stars, the analysis of Σ^- stars and conclusions that can be drawn from the experimental data are presented. 84 pages. $2.00.

AN INVESTIGATION OF THE BETA AND GAMMA RADIATIONS EMITTED IN THE DECAYS OF SEVERAL SHORT-LIVED NEUTRON-INDUCED RADIOACTIVITIES

(L. C. Card No. Mic 58-957)

David Willis Martin, Ph.D.
University of Michigan, 1957

The radiations emitted by seven fairly short-lived radioactivities have been studied. Gamma rays were studied with multi-channel scintillation spectrometers using NaI (Tl) detectors, and with photographic magnetic spectrographs. Beta rays were measured qualitatively by means of anthracene scintillation spectra and by aluminum-absorption techniques. Coincidence measurements have been made, and intensities have been estimated. A decay scheme has been established or proposed for each case. Spin and parity assignments for the levels based on the nuclear shell model have been made wherever possible.

Ca^{49} (8.9-min.) is found to decay to three excited states of Sc^{49} at 3.07, 4.04, and 4.7 Mev respectively. The first two may be interpreted as single-particle $p_{3/2}$ and $f_{5/2}$ states, while the ground state is $f_{7/2}$. The indicated $f_{7/2} - f_{5/2}$ energy difference of 4.04 Mev is substantially larger in this nucleus than in any other.

Sc^{49} (57-min.) is found to decay with the emission of only a single beta component to the ground state of Ti^{49}, as has been previously reported.

Mo^{101} (14.6-min.) is found to have a very complex decay scheme. Evidence is found for 22 gamma rays ranging up to 2.08-Mev energy, and at least 5 beta-ray components. The highest-energy beta component of 2.2 Mev proceeds to an excited level at 0.590 Mev. The previously known strong gamma transition of 0.1912 Mev is found to follow a delayed state having a half-life of 9.1×10^{-4} seconds, and its K-conversion coefficient is estimated to be about 0.30; both of these facts indicate a probable M2 or E3 interpretation. A decay scheme is proposed involving 10 excited states of Tc^{101}, which contains all but two of the gamma rays, and is compatible with all coincidence and intensity data. The delayed state is believed to be the first excited state, lying at 0.1912 Mev. It appears not to be the expected $p_{1/2}$ single-particle state. The ground state is taken to be $g_{9/2}$, as previously supposed.

Tc^{101} (14.3-min.) decays to excited levels in Ru^{101} at

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0.3069, 0.543, and 0.838 Mev with relative intensities of 94, 5.0, and 0.9 per cent respectively. Five gamma rays are emitted, and the scheme involves one additional excited state at 0.126 Mev. The ground state is $d_{5/2}$, and the 0.3069-Mev state is probably 7/2+.

I^{128}(25.0-min.) decays to the ground state and to two excited states of Xe^{128} at 0.452 and 0.987 Mev respectively; both excited states may be identified to have the character 2+. I^{128} also decays by electron capture to the ground state and one excited state at 0.76 Mev in Te^{128}. The character 1- for the ground state of odd-odd I^{128} is indicated by the intensity data, in conflict with the predictions of Nordheim's rules for this nucleus.

Ce^{143} (33.4-hr.) is found to decay to six excited states of Pr^{143} at 0.0574, 0.232 (or 0.493), 0.351, 0.724, 0.918, and 1.16 Mev. There is no observable beta transition directly to the ground state. Ten gamma rays ranging up to 1.10 Mev are emitted. The ground state of Ce^{143} is probably $h_{9/2}$, while the ground and first-excited states of Pr^{143} are $d_{5/2}$ and $g_{7/2}$ respectively. The K-conversion coefficient of the 0.0574-Mev gamma transition is measured to be about 5.9, consistent with an M1 interpretation.

Yb^{177}(1.9-hr.) decays to the ground state and to excited states of Lu^{177} at 0.1.21 and 0.150 Mev, as previously reported. In addition, a very low-energy beta component of about 0.07-Mev energy and 3.6% intensity proceeds to an excited state at 1.228 Mev. The K-conversion coefficient of the 0.150-Mev gamma transition is estimated to be about 0.41. Agreement with the beta-ray intensities is obtained if it is assumed that this transition is predominantly E2, the Yb^{177} ground state is $p_{3/2}$, and the ground and 0.150-Mev states of Lu^{177} are $d_{5/2}$ and $g_{7/2}$ respectively. These assignments provide no explanation for the reported half-life of 1.2×10^{-7} seconds of the 0.150-Mev level.

145 pages. $2.00.

PHYSICS, SOLID STATE

RECOMBINATION OF INJECTED CARRIERS AT DISLOCATIONS IN SEMICONDUCTORS

(Publication No. 22,857)

John Philip McKelvey, Ph.D.
University of Pittsburgh, 1957

Recombination of injected charge carriers at dislocations in semiconductors is studied by examining the recombination of carriers in the neighborhood of a Burgers lineage boundary. Since the linear dislocation density in such a boundary can be determined easily and accurately, the properties of individual dislocations in the array can be inferred from the properties of the lineage array by simple calculations.

The boundary conditions on the continuity equation for injected minority carriers are derived using a kinetic approach, and are expressed in terms of absorption (recombination) and reflection (backscattering) probabilities. The effect of bulk recombination in the adjacent material is expressed as a bulk reflection probability. The effect of an applied electric field is considered. The kinetic approach is dictated by the fact that the scattering and absorption processes are multiple ones and are not amenable to treatment by ordinary scattering calculations.

The continuity equation is solved using these boundary conditions, and the carrier concentration in the neighborhood of the lineage boundary is thus related to the recombination probability. The recombination probability is related to the recombination cross section of a single dislocation by a simple formula which involves only the linear density of dislocations in the linear array.

Concentrations of injected carriers on either side of the lineage boundary are measured experimentally using point-contact collectors, and results are calculated using the relations derived previously. Absorption coefficients and recombination cross sections are measured and are found to be independent of the sweep field, in agreement with the predictions of the theory. The cross sections are found to be those of cylinders about 1.15 Å in diameter for holes in n-type germanium and 2.8 Å in diameter for electrons in p-type germanium.

Using these results, a simple calculation is made to relate bulk carrier lifetime with dislocation density, and it is found that for crystals with normal dislocation density the results are in good agreement with upper values of carrier lifetime actually observed in such crystals. It is concluded that processes at dislocations play an important role in carrier recombination in the usual melt-grown germanium crystals produced by current crystal growing techniques. 112 pages. $2.00. Mic 58-4842

METABOLIC CHANGES IN THE HYPOTHALAMUS OF THE RAT RESULTING FROM STRESS AND ADRENALECTOMY

(L. C. Card No. Mic 58-1257)

Harold Goldman, Ph.D.
University of Illinois, 1957
Chicago Professional Colleges

Hypothalamic nucleic acid content has been studied in rats which were subjected to the stresses of sham operation, bilateral adrenalectomy, and cold for two hours at $3^{\circ} \pm 2^{\circ}$ C. The purine and pyrimidine components of the nucleic acids were liberated by hydrolysis, then chromatographed on paper, eluted from the paper and quantitatively measured by means of their characteristic ultra violet absorption. In addition, hypothalamic ATP turnover was determined in sham operated and adrenalectomized rats, and in the latter group creatine phosphate was also measured. In connection with the analysis of ATP an automatic chromatographic fraction collector and radioactivity recorder was developed and is described in detail.

The three forms of stress employed, at least during the first week postoperatively, cause qualitatively similar decreases in nucleic acid. It must be noted also that the effects of surgical manipulation are obvious in nucleic acid for at least three weeks postoperatively. The concentration of nucleic acid, as measured by the content of its component purines and pyrimidines, is decreased, except for thymine, in non-operated but cold stressed animals by 20 to 30 per cent. Surgery and adrenalectomy cause at least 20 and as much as 45 per cent reduction in nucleic acid content, again with the exception of thymine. The purine and pyrimidine bases, adenine, guanine, and cytosine, recover to normal levels by the second week postoperatively. On the basis of a relatively constant thymine, and presumably DNA level, the major change in the nucleic acids is considered to occur in the PNA fraction. The significance of an apparent increase in thymine concentration in cold stressed adrenalectomized or sham operated animals 5 to 7 days postoperatively is discussed.

Despite the fall in content, the molar composition of nucleic acid is not altered significantly after cold stress or during the first week postoperatively. During the second and third weeks however, the composition does change and is particularly noticeable in marked and parallel increases in guanine and cytosine. The significance of such a change in the nucleic acid composition is discussed from a structural as well as a functional viewpoint. With the exception of adenine the effects of surgery and adrenalectomy upon hypothalamic nucleic acid appear to be qualitatively and quantitatively the same. It is suggested that the effects of all three forms of stress on the metabolic activity of the hypothalamus are similar and that the prolonged low adenine in the case of adrenalectomy is an indication of the relatively chronic nature of the stress.

The marked changes in the nucleic acids are taken as an indication of increased hypothalamic metabolic activity in response to these stresses. This contention is supported by the disappearance and recovery of creatine phosphate in the case of adrenalectomy, in parallel with the changes in the nucleic acid bases, and by the rapidity of the turnover of ATP in both sham operated and adrenalectomized animals. The significance of the nucleic acids and high energy compounds in relation to neuronal protein synthesis and coenzyme function is discussed.

87 pages. $2.00.

THE RESPIRATORY PIGMENTS

(L. C. Card No. Mic 58-1296)

Clyde Pat Manwell, Ph.D.
Stanford University, 1958

Purpose: (1) To develop a technique for determination of the oxygen-respiratory pigment equilibrium using small samples of respiratory pigment under controlled conditions of temperature, pH, ionic strength, and carbon dioxide tension. (2) To investigate the oxygen equilibria of the hemoglobins of various vertebrates and the hemoglobins, hemocyanins, and hemerythrins of various invertebrates that: (a) have not been previously studied in this respect, and (b) show some interesting physiological or ecological situation in which the respiratory properties of the blood might be involved. (3) To collate this new information with a synthetic approach to the respiratory pigments in general.

Investigations and Interpretations:

(1) The myoglobin of the amphineuran mollusc Cryptochiton stelleri is similar in some respects to mammalian myoglobins; however, under certain conditions the oxygen dissociation curve of Cryptochiton myoglobin is sigmoid.

(2) The absence of a Bohr effect appears to be a much more frequent occurrence than has been previously suspected. Interactions between oxygen-affine and proton-affine centers (heterointeractions) have been found to be lacking in the hemoglobins of Eupolymnia and Cucumaria miniata, the hemocyanin of Cryptochiton, and the hemerythrin of Phascolosoma.

(3) Fetal hemoglobins have been found in the bony fishes and the elasmobranchs, as well as the rat. This ontogeny of hemoglobin can be correlated with the intrauterine ecology in the ovoviviparous spiny dogfish Squalus suckleyi, and the viviparous rat and the surf-perch Embiotoca lateralis. A transient embryonic hemoglobin is present in the development of the oviparous skate Raja binoculata. The pelagic postlarva of the cabezone Scorpaenichthys marmoratus possesses a hemoglobin distinct from that of the adult.

(4) The hemoglobins of two species of diving birds are similar to those of non-diving birds except with regard to the Bohr effect, which is reduced in the diving species.

(5) Application of the alkaline denaturation technique to the differentiation of various hemoglobins indicates that, while the technique is useful in the case of fetal and adult hemoglobins, the supposed "microheterogeniety" of normal

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hemoglobins based upon this method rests on extremely dubious grounds.

(6) Calculation of the entropies of oxygenation indicate that oxygenation is accompanied by an increase in the order of the protein molecule in not only hemoglobin but also hemocyanin and hemerythrin. This finding, as well as others, lends support to a "theory of configurational change" which is used to explain the reversibility of the oxygenation reaction, the stability of the oxy- form of the respiratory pigment, the specificity of respiratory pigment reactions with other substances besides oxygen, and the Bohr effect.

(7) Comparisons of the oxygen-hemoglobin equilibrium inside and outside of the erythrocyte have indicated that, while there is little difference for the hemoglobins of certain species, striking effects are observed in some cases. In several teleosts and in the holocephalian Hydrolagus (Chimaera) there is a striking suppression of the heme-heme interactions by the red blood cell—a situation which also has phylogenetic implications, for the effect is not shown by elasmobranch hemoglobins. In the garter snake Thamnophis a very large "fetal-maternal shift" is attained through intracellular modification of the same—or very similar—protein(s). Such studies force the conclusion that the properties of a protein inside the cell are often different from the properties observed outside the cell, even when the protein has not been subjected to any extensive purification. 292 pages. $3.75.

APPLICATION OF MANOMETRY TO KINETIC ANALYSIS OF MAMMALIAN CELL MULTIPLICATION IN STATIONARY MONOLAYER CULTURE

(L. C. Card No. Mic 58-1162)

John D. Ross, Ph.D.
University of Minnesota, 1957

A modified Warburg vessel was designed for use with standard Warburg manometers, to accommodate a commercially-available sealable culture dish with plane floor. With these vessels periodic measurements of oxygen consumed by counted numbers of viable cells established in unreplenished fluid medium in stationary monolayer culture were made during incubation periods as long as five days. Relative degree of cell multiplication was determined from initial and final counts, made with aid of an ocular reticle and phase microscope, of cells in individual cultures. Logarithms of microliters of oxygen consumed cumulatively regressed linearly on logarithms of hours of culture incubation. Observation of cells of a variety of stable and clonal strains established in continuous culture, and of monkey kidney cells in secondary culture, revealed distinctive patterns of respiration change. Graphical regressions showed phases analogous to the lag, retardation, and stationary or decline phases descriptive of bacterial growth curves. One or more of these phases was influenced by inoculum density; commonly both metabolic "growth rate" and net culture increase were inversely related to inoculum size. Appropriate mathematical analysis of respiration kinetics produced a quantitative description applicable to investigation of culture growth behavior. Studies with HeLa and human liver epithelial cells showed that respiration rate of change, within limits, was independent of medium concentration. Alterations of medium constitution and depth, and of culture atmosphere, affected the parameters but not the form of oxygen-consumption regressions. Net culture population increases were compatible with existence of a positive correlation between culture growth and respiration rate, except under conditions affecting oxygen supply. 67 pages. $2.00.

STUDIES OF CONGENITAL TREMOR IN PIGS

(L. C. Card No. Mic 58-1163)

Melvin W. Stromberg, Ph.D.
University of Minnesota, 1957

An investigation has been conducted into several aspects of a disease of baby pigs known as myoclonia congenita and characterized by the presence of a tremor which is usually congenital.

About 80 outbreaks of this disease were recorded over a two year period. Forty-two of these outbreaks were investigated with the following results:

1. On the basis of records obtained from owners, the incidence of affected litters is considerably greater among the off-spring of gilts than of sows.
2. The data collected give no support to the theory that the disease results from inadequate nutrition for the dam.
3. The data collected give no support to the theory linking this disease with hog cholera.
4. Myoclonia congenita occurs in a wide variety of breeds.
5. It was not possible to reproduce this disease by mating closely related animals which once showed tremor symptoms.
6. It was possible to reproduce this disease in three out of four litters by using a "tremor producing" boar as sire.
7. Data on field cases and experimental breeding strongly indicate that the boar plays a significant role in the transmission of this disease, and that there is little or no basis for adhering to a genetic theory of etiology.
8. A common necropsy finding in pigs with myoclonia congenita has been thickening, edema, and focal hemorrhages in the meninges over the cerebellum. These changes were usually most marked in the region of the transverse venous sinus.
9. Preliminary histopathological studies indicate no marked differences in the morphology of nerve cells and nerve fibers in affected versus control animals. However, widespread vascular changes of mainly a proliferative nature have been observed microscopically in diseased pigs. These finds suggest that the basic lesions in this disease are vascular in nature.
10. The results of a number of trials indicate that parenterally administered epinephrine will markedly aggravate existing tremor and in many instances produce a temporary resumption of tremor symptoms in recovered pigs. These effects of epinephrine administration were observable for as long as 24 hours in some pigs.
11. The segmental reflex response of the first sacral

segment was recorded in 23 pigs and analyzed as to maximum and minimum monosynaptic latency, maximum and minimum multisynaptic latency, duration of monosynaptic spike, duration of second and third waves, comparative threshold of monosynaptic and multisynaptic response, ratio of monosynaptic maximum amplitude to second wave maximum amplitude, and time lapse between peaks of reflex response.

12. Segmental reflex response characteristics in pigs with tremor differed notably from those of control pigs with respect to all of the above characteristics except maximum and minimum latency of the first wave, and maximum latency of the second wave.

13. The effect of dorsal root tentanization on the first sacral segmental reflex was tested in 15 pigs (56 trials). The responses were analyzed with respect to duration of monosynaptic and duration of second wave potentiation to the 70 per cent relaxation level, and comparative maximum amplitudes of first and second waves following dorsal root tentanization.

14. With respect to the above characteristics, marked differences were demonstrated between control pigs and pigs with tremor. Less marked differences were observed between control pigs and recovered pigs.

15. On the basis of the information available, this disease appears to be infectious in nature, but further work is needed to demonstrate this.

16. The nature of the spinal cord reflex response in pigs with tremor suggests increased excitability via two neuron-arc pathways and decreased excitability via multineuronal pathways. 165 pages. $2.20.

EFFECTS OF SPATIAL AND TEMPORAL STIMULUS VARIABLES ON THE ACTIVITY OF SINGLE RETICULAR NEURONS

(L. C. Card No. Mic 58-1099)

Hardress Jocelyn Waller, Ph.D.
University of Washington, 1957

Spatial and temporal patterns of activity in the mesencephalic reticular formation were investigated by analysis of the discharges of individual neurons to peripheral stimuli. Responses were related to changes in position and intensity of a stimulus, and to the time interval between successively administered stimuli. Glass micropipettes 0.5 to 12 microns tip diameter were inserted into the midbrain tegmentum and adjacent structures of locally anesthetized and paralyzed cats. The size of receptive fields was estimated by the number of paws from which responses could be elicited by standard electrical stimuli, and by the extent of skin areas from which discharges could be induced by cutaneous stimuli.

Single neurons responsive to somatic stimulation were widely distributed, but were most frequently encountered in the dorsolateral tegmentum. The initial activation of most reticular neurons by a single somatic stimulus occurred within a time interval of 20 milliseconds; the long time course of multi-unit potentials recorded with large electrodes is more closely related to the duration of repetitive firing of individual neurons. Latencies of initial discharges were unrelated to location within the midbrain, and neighboring neurons often revealed widely differing latencies, number of discharges, receptive fields, and thresholds. Thus, progressive interneuronal spread of activity to adjacent neurons was not evident at the midbrain level.

Some neurons responded to very light touch of a few hairs over extensive portions of the body surface. Receptive fields of different neurons differed predominantly in size rather than in position on the body surface. Although larger receptive fields were more often demonstrated by more lateral neurons, no evidence for a dermatomal representation was found. However, neurons responsive to stimulation of any paw responded as a group with a greater number of discharges than neurons not responsive to one or more of the somatic inputs. Thus, stimuli applied to different paws activate different numbers of neurons with approximately equal effectiveness.

The latency of the initial discharge, the number of repetitive discharges, and the intervals between discharges of a single neuron often differed significantly when different paws were stimulated. The number of discharges elicited from different paws could be equated by alterations of stimulus intensity. Changes in initial latency produced by variation of intensity usually were smaller than changes produced by alteration of stimulus position. Latency changes during occlusion or inhibition by a previous peripheral stimulus were either transient or absent, as a result of selective depression of the later discharges of a repetitive train. The temporal pattern of activation of reticular neurons is to some extent independent of stimulus intensity and might provide a basis for a limited representation of body space. 143 pages. $2.00.

The items following each abstract are: the number of manuscript pages in the dissertation, its cost on microfilm, and the Library of Congress card number. Enlargements 5-1/2 x 8-1/2 inches, 4 cents per page. No postage is charged if check or money order accompanies order.

POLITICAL SCIENCE, GENERAL

THE NATIONAL ASSOCIATION FOR THE ADVANCEMENT OF COLORED PEOPLE AND THE NATIONAL LEGISLATIVE PROCESS: 1940-1954

(L. C. Card No. Mic 58-1411)

David William Hazel, Ph.D.
University of Michigan, 1957

The purpose of this study is to investigate the methods and effectiveness of the NAACP as a special-interest group seeking to influence the national legislative process during the years 1940-1954.

The legislative program of the NAACP during the period is divided into two parts: major specific objectives and major general aims. Specific objectives are antilynching legislation, anti-poll-tax legislation, and FEPC legislation. The study examines the need for such legislation, its nature, and the character of the opposition to the proposed legislation. Major general aims are equalization of education, equalization of housing, and equalization of treatment in the armed forces. The study explores the need for safeguards and for modification of existing legislation related to these general aims.

An analysis is made of the techniques used by the NAACP in preparing its legislative program, in working out lobbying strategies, and in attempting to bring an end to obstructionist tactics, such as the filibuster, used by the opposition. The specific functions of the various agencies of the organization are outlined.

The analysis rests heavily upon review of the debates in Congress as well as published congressional committee hearings. Particular attention is devoted to unpublished materials made available from the files of the NAACP. Under the original plan interviews with congressional leaders were to have been heavily stressed. However, difficulties in gaining cooperation proved serious and, consequently, interview data have not contributed as significantly to this analysis as originally contemplated.

Conclusions to be drawn from the study are as follows: (1) The NAACP has not been successful in achieving its major specific aims. (2) The NAACP has been moderately successful in achieving its major general aims. (3) The NAACP has been indirectly responsible for much progress in civil rights in recent years. (4) In view of a recent change toward stiffer, uncompromising tactics by the NAACP, its legislative program is unlikely to be enacted into law in the near future. 308 pages. $3.95.

SOME ASPECTS OF PUBLIC LIABILITY IN FRANCE AND GERMANY

(L. C. Card No. Mic 58-1082)

Heinz R. Hink, Ph.D.
University of Washington, 1957

Traditionally the common law countries have not permitted suit against the state for wrongful acts committed by a public servant in the exercise of governmental authority. The Federal Tort Claims Act, 1946, and the British Crown Proceedings Act, 1947, have replaced the strict common law rule of sovereign immunity and in a number of cases tort actions against the state now are possible. But the narrow judicial interpretation of these acts, especially in the United States, leaves the common law jurisdictions perceptibly "lagging behind" the far-reaching rules of public liability in civil law France and Germany.

The French Council of State has developed an imposing body of autonomous rules of administrative liability enforceable before special tribunals of administrative jurisdiction. The result is a system of judge-made administrative law which permits the review of every administrative act both from the point of view of its annulment for illegality (recours en annulation) and with regard to actions for damages in tort (recours en pleine juridiction). Increasingly administrative liability in France is based on the notion of "risk" or "social insurance," according to which the state is liable on "objective" grounds independent of any fault on part of the acting official.

But the usefulness of the French system of public liability is dependent on the acceptance of its basic assumption, i.e., on the existence of a separate body of administrative law parallel to, and independent of, the rules of private law. The existence of such a dual system of laws and jurisdictions is contrary to the Anglo-American concept of the "rule of law." For that reason the present study suggests that the German solution in the field of governmental liability warrants closer attention by the American student. First, like France, Germany has developed extensive rules of public liability. But, unlike France, in Germany tort actions against the state for torts of governmental agents are brought before the ordinary courts of law. Although the power to amend administrative acts is reserved to special administrative tribunals, the German legislator felt that in public tort actions the ordinary courts alone could offer the assurances necessary for a fair and independent-minded hearing against the sovereign state. Second, the German system of governmental liability is based on fault rather than on objective causation. The state's liability is a vicarious one, i.e., the body politic assumes the financial burden incurred by the fault of its agent.

On both counts German law is in line with the common law development. The far-reaching scope of actionable torts for which Amtshaftung is available in Germany

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suggests a possible goal for American reform. Most cases brought before the German courts involve precisely the kind of violation with regard to which the Federal Tort Claims Act precludes suit against the United States. But the common law jurisdictions also may avoid one serious shortcoming of the German system. Once suit against the federal government is freed of its present excessive restrictions, American courts will be able to combine the power of review with jurisdiction over tort actions. Potentially the American courts are thus capable of preserving the unity of jurisdiction which is non-existent in Germany and which French law achieves only by the radical withdrawal of all tort claims against the state to special administrative tribunals. The common law courts are in a position where, unlike the German courts, they can enjoy a wide range of jurisdiction over administrative acts similar to that enjoyed by the administrative tribunals in France.

430 pages. $5.50.

THE FOREIGN POLICY AND FOREIGN POLICY THEORY OF THE AMERICAN SOCIALIST PARTY, 1901-1920

(L. C. Card No. Mic 58-1136)

Walfred Hugo Peterson, Ph.D.
University of Minnesota, 1957

Before the first World War the American Socialist party was not significantly interested in foreign policy in spite of its avowed internationalism. In marked contrast with the platforms of major parties, the Socialist platforms said almost nothing about foreign policy. This silence appeared in other official and semi-official actions and in almost all Socialist literature. Even serious intra-party conflicts on immigration law were scarcely ever related to foreign policy. While Mexican-American friction after 1910 provoked Socialist action, the party offered no policy suggestions other than a negative "hands off Mexico" stand.

This lack of foreign policy interest was produced in part by several factors related to the politics and nature of American socialism. The party's predecessors had not been much concerned with these matters. The Socialists failed to acquire power in the national government, which formulates foreign policy. In 1900 the pre-unity socialist groups faced Bryan's campaign on imperialism, and the party hesitated to become identified with a bourgeois reform issue. The Socialists' "immediate demands" were influenced by the interests of organized labor, which then was almost exclusively concerned with domestic affairs. Further, in theoretical outlook the Socialists were impossibilists on foreign relations. This meant that reform of international affairs within capitalism was regarded as impossible. The sole remedy for imperialism and war was socialism. This impossibilism partially contradicted both general Socialist political thought and Socialist domestic policy, for in these matters the majority Center and Right wings were opportunists who advocated immediate reforms. Also this impossibilism centered the attention of the supposedly internationalistic Socialists on the nation-state where the revolution was to occur.

This foreign policy position changed in August, 1914, when many Socialists began proposing foreign policy programs to end the war and make American participation in it unlikely. This opportunism made possible the formulation of a comprehensive peace program in 1915, which Socialists later boasted was the first proposal of a democratic peace. The aims stressed in this and later documents were lasting peace, the democratization of international relations, anti-imperialism, anti-militarism, and internationalism. These aims were similar to those of liberal bourgeois parties, but the Socialist party was unique in that it also sharply opposed American participation in the war, though this opposition was diminishing in 1918.

The foreign policy change in 1914 was related to the continuing Rightward party shift, to the brutality, size, and political importance of the war, which forced Socialists to become concerned with the here and now, and to the realization that bourgeois foreign policy and war had retarded the progress of international socialism by destroying the supposed international solidarity of the European parties. Further, the theories of many Socialists about the causes and nature of the war and international relations shifted away from pre-war impossibilism. The pacifist, pro-war, and defensive-war factions challenged the pessimistic fatalism of the older view. They looked for remedies within capitalism.

The new radicalism partly inspired by the Russian revolution helped move the party toward a foreign policy impossibilism in 1919, but the party splinterings of that year insured that the remnant Socialist party would continue foreign policy opportunism into the post-war era. However, the purged party was not so opportunistic that it could accept the compromises of the peace treaties and the League, and it opposed Wilson's post-war foreign policy.

Excepting the 1917 anti-war proclamation, foreign policy decisions did not play a controlling part in Socialist history, but foreign policy decisions did reflect the basic problem the party faced of being opposed to bourgeois society and yet being a political party within that society.

517 pages. $6.60.

LABOR AND POLITICS IN POSTWAR JAPAN: A STUDY OF THE POLITICAL ATTITUDES AND ACTIVITIES OF SELECTED JAPANESE LABOR ORGANIZATIONS

(L. C. Card No. Mic 58-1464)

James Rudolph Soukup, Ph.D.
University of Michigan, 1957

The objective of this study is to determine whether or not the political attitudes and activities of Japanese trade unions are conducive to the development of democracy. In answering this question, two assumptions are made. First, to the degree that they follow the Communist Party line unions are not contributing to the development of democratic institutions. Second, to the extent that they accept the doctrine that political change should be effected by parliamentary rather than violent, revolutionary means and display a willingness to compromise and recognize the rights of other groups trade unions are conforming to democratic norms.

Although historical materials such as Japanese and American government documents and Japanese trade union publications were examined, the generalizations in this study are based primarily upon interviews with Japanese union officials. Special attention is given to information supplied by leaders from five national unions. Three of these unions (Japan Coal Miners' Union, National Railway Workers' Union, Japan Electric Industry Workers' Union) are affiliates of Japan's largest labor federation, the General Council of Japanese Trade Unions (Sohyo). Another union, the Japan Seamen's union, is a member of Sohyo's chief rival, the Japanese Trade Union Congress (Zenro). The remaining union, the National Federation of Electric Workers' Unions, is an independent labor organization.

The analysis is organized into four parts. Part One contains an account of postwar labor developments. Part Two deals with the political attitudes of major labor organizations and their leaders. Specifically, their views regarding domestic economic policy, foreign policy, and the proper means of attaining political goals are examined. In Part Three emphasis shifts from the realm of thought to that of practice. Stress is placed upon union election activities and relations with political parties. Labor lobbying and recent left-wing union efforts to organize mass political movements are also discussed.

The conclusions of the study are presented in Part Four. These conclusions are:

1. Present activities of a majority of Japanese labor unions are hindering more than aiding the development of democracy. Few labor leaders are communists, but Sohyo is dominated by left-wing socialists whose views are nearer to those of communism than Western democracy. Sohyo officials oppose subservience to Moscow, violent revolution, and party control of union affairs. Nevertheless they (a) blame the West for the present international crisis, (b) use semi-revolutionary techniques such as strikes and mass demonstrations to pressure the government, and (c) are reluctant to compromise with rival groups.

2. However, as they mature, Japanese unions are likely to become more moderate. Zenro officials attack Sohyo's policies and endorse the principles of Fabian socialism. Though critical of American foreign policy, they are ideologically inclined to support the Western democracies. Domestically, they defend parliamentary government and are willing to compromise. Today, Zenro is less powerful than Sohyo. However, the radical core of Sohyo is composed largely of government workers whose activities are gradually being restricted. Also, many rank and file workers are not overly enthusiastic about leftist political tactics. Within Sohyo there are already signs that some leaders feel they must moderate their views. Members of the Iwai-Ota group which recently assumed command of Sohyo are less doctrinnaire and less pro-communist than their predecessors.

3. Labor's political power is neither negligible nor strong. The Socialist Party is dependent upon unions for money, candidates, and organizational support. However, union attempts to elect a socialist majority have failed. To succeed trade unions must raise the political consciousness of workers, attract more votes from conservative farmers, mend serious internal rifts, and resist government restrictions. Nevertheless, labor organizations are in a position to cause political stalemates and their leaders are making a determined effort to overcome the above obstacles. 336 pages. $4.30.

POLITICAL SCIENCE, INTERNATIONAL LAW AND RELATIONS

BRITISH ATTITUDES TOWARD EUROPEAN UNITY AS REFLECTED BY THE PARTICIPATION OF THE UNITED KINGDOM IN THE COUNCIL OF EUROPE

(L. C. Card No. Mic 58-1023)

John Wilbur Price, Ph.D.
University of Michigan, 1957

Through intensive analysis of verbatim reports of debates (1949-1954) in the Consultative Assembly of the Council of Europe, this study seeks to discover and explain the British attitude toward European unity. The first chapter reviews the history of the idea of a united Europe, especially since World War I. A high correlation is noted between wars and movements for unity. The second chapter describes the British role in creating the Council of Europe, emphasizing Churchill's initiative and Labourite opposition. The British Government acceded to the Statute of the Council of Europe only after a Committee of Ministers, with power of national veto, had been added to the original conception of a supra-national Consultative Assembly.

The next three chapters discuss reasons given by British representatives for opposition to European federation, whether total (as advocated by the maverick Labourite, R. W. G. Mackay) or sector-by-sector (through creation of specialized communities) or partial (meaning the proposed European Political Community). The main reasons are: determination by all parties not to jeopardize relationships between Britain and the Commonwealth and Empire; insistence by socialists upon national planning; workingmen's fear of a lowering in their standard of living; and instinctive opposition deriving from national characteristics. The British Labour Government vexed Continental federalists by refusing to join the European Coal and Steel Community and the European Defense Community, on the grounds that both were too supra-national in character. In opposition, the Conservatives pressed for a more positive and cooperative approach to Continental proposals; and after the change of government in 1951, Britain became associated with the Coal and Steel Community and joined the substitute for the defunct Defense Community, both nascent organizations having become less and less supra-national during negotiations.

While refusing to federate, the British also considered it against their national interest to allow six Continental countries to form a federation called "Little Europe," since the resultant European Political Community would probably be dominated militarily and economically by

Germany. Because Scandinavia avowedly followed the British, the Benelux countries hesitated and France in the end refused to venture into new groupings without Britain, the movement toward unity came to a standstill, waiting for British leadership.

Chapter VI outlines the British conception of their role in Europe — not a federal Europe but a loose confederation or commonwealth of European states and overseas associates. The Conservatives have steadfastly regarded Britain as the center of three concentric circles, one embracing the Commonwealth, another the United States, and the third Western Europe. They are seeking some form of international organization which will enable the United Kingdom to play its part in all three circles. Two important proposals advanced in the Council of Europe by Britons, the Eden Plan in the political field and the Strasbourg Plan in the economic field, illustrate how the British Conservatives might be willing to establish the closest possible association with Europe, leading toward ultimate unity.

The final chapter assesses Britain's motivation and role in the Council of Europe. Of four historical stimuli to union — military, economic, cultural, and political — the last two are virtually inoperative in present-day Britain. The other two are rather weak, for militarily Britain is securely backed by the United States in the North Atlantic Treaty Organization and economically Britain already has a large trading area in the Commonwealth and Empire. If European unity is to be attained peaceably, therefore, the most important task now is to strengthen in British minds the will to unite. 283 pages. $3.65.

THE INTERNATIONAL MILITARY TRIBUNAL FOR THE FAR EAST AND THE LAW OF THE TRIBUNAL AS REVEALED BY THE JUDGMENT AND THE CONCURRING AND DISSENTING OPINIONS

(L. C. Card No. Mic 58-1092)

Walter Lee Riley, Ph.D.
University of Washington, 1957

The decision to wage or to conspire to wage war, whether a justified war or not, has never given rise to individual responsibility according to the traditional ideas of international law. The International Military Tribunal for the Far East set up at Tokyo disagreed with this principle and declared that the international law provided for the punishment of persons found guilty of war crimes. Specifically the Tribunal declared that launching an aggressive war was a crime, a proposition which, if it could have been substantiated, would have represented one of the most momentous developments in the history of international law.

To make the waging of aggressive war or conspiracy to wage aggressive war a crime under international law, and to hold that those who process the war are individually responsible, represents a new approach. There was no precedent for it, and moreover, no basis in previous agreement. It was clearly ex post facto. "According to law" to the Tribunal did not mean according to "international law"; it meant "according to the law laid down in the Charter of the International Military Tribunal for the Far East."

This century has seen some legal development and construction in the international field, but twice it has been disrupted by world wars, one of which introduced the concept of total war. The post war trials at Nuremberg and Tokyo and the United Nations Charter were attempts by states to seek out solutions for the preservation of peace. The efforts to create an international legal order of which criminal justice is a part has been started. It was not, however, based on universally known and accepted legal rules. The reason was the nature of the Tribunals and the "extraordinary political proceedings" which provided a poor base upon which to rest such an institution.

No one it would appear would dissent from the punishment given to those who caused so much suffering and desolation to so many. If they had been tried and sentenced by any procedure under joint or several military jurisdictions as so many had by Military Courts and Commissions in liberated areas there could have been no juridical protest. What is questioned is the propriety of throwing the onus of punishment into legalistic form and interpreting for history the appearance of an international judicial process for judging political and military leaders.
218 pages. $2.85.

POLITICAL SCIENCE, PUBLIC ADMINISTRATION

THE RELATIONSHIP OF PERSONNEL SELECTION AND SALARY ADMINISTRATION TO ORGANIZATIONAL EFFECTIVENESS IN THE COOPERATIVE EXTENSION SERVICE IN MICHIGAN

(L. C. Card No. Mic 58-800)

George Harold Axinn, Ph.D.
The University of Wisconsin, 1958

Supervisor: Professor Eugene A. Wilkening

The central problem of this study was to determine the relationship of personnel characteristics, such as age, rank, tenure, sex, intelligence, interests, and personality to salary and performance. An effort was also made to show the relationship between various alternative systems of classification of personnel for salary administration, and the most likely consequences of each to the organization. There was also an attempt to show the relationships between the various alternative systems of selecting new personnel and their consequences.

In an analysis of organizational structure, a gradual shift, since 1941, from a functional-type to an areal-type was shown. Evidence was presented which suggests that this trend is likely to continue.

Based on this trend, the assumption is made that certain structural changes will be made at state, district, and county levels. The most significant of these to this study is the establishment of an office of staff services which would include the centralizing of the personnel administration functions.

From an analysis of decision-making, it is inferred that in all decisions, except those of the most personal nature, those members of the staff who are involved in the consequences of a decision are also involved in the making

of the decision. Although the formal organization has made the change from functional to areal mode in the field, this change has not been fully accepted in operational procedures.

Salary levels of members of the field staff are highly related to such characteristics as age, length of tenure, academic achievement, and sex. Salary levels are more closely related to other characteristics than they are to the particular title held.

Women in the organization do not enjoy salary rewards equal to those of men. This applies both to the level of salary being received and the amount of increases granted.

Personal performance ratings are shown to be directly related to both the level of salary received and the size of the last salary increment. It is also established that labor turnover among women in the field staff is considerably greater than among men, with the exception of the Assistant Agricultural Agents.

Members of the field staff with master's degrees tend to have higher salaries, and more of them have higher performance ratings, than persons with only bachelor's degrees.

Full-time specialists do not have as high rank or as high average salaries as either part-time specialists or full-time research and teaching staff members, even when such factors as age, length of tenure, sex, and academic achievement are held constant. It is suggested that specialists salaries be administered with those of the field staff.

Neither tests of intelligence, personality, nor interests prove to be positively related to performance ratings.

A system of job evaluations based on an abilities and knowledges classification is proposed. A salary scale with six grades and with standard job normals increasing by ten percent in the first four grades, and twelve to fifteen percent in higher grades is also proposed. Other recommendations are made for control of salaries and selection of personnel.

In general, this thesis demonstrates the complexity of personnel problems, and the need for consideration of the dynamics of organizational structure when dealing with them. 357 pages. $4.60.

ADMINISTRATIVE DOCTRINE AND ADMINISTRATIVE BEHAVIOR: THE AEC EXPERIENCE

(L. C. Card No. Mic 58-1442)

Robert Milton Northrop, Ph.D.
University of Michigan, 1957

This study examines the influence of administrative doctrine on administrative behavior in the United States Atomic Energy Commission. The term administrative doctrine refers to principles of administration or types of administrative behavior which are repeatedly explained, justified and recommended as desirable - preached, in other words. Administrative doctrine is a phenomenon of organizational life which, it is postulated, can serve the primary function of promoting consistent administrative behavior throughout an organization, but can also act as a defense mechanism against opposition from outside the organization.

The study begins with a preliminary examination of the genesis of the Atomic Energy Commission, showing that the agency offers an organizational setting wherein administrative doctrine flourished. The study then summarizes the original administrative doctrine, developed immediately after creation of the AEC in 1946, under the leadership of the first Chairman, David E. Lilienthal. This doctrine provided for reliance on the contractor system of operation of the atomic energy program under loose supervision by the AEC, for a strongly decentralized AEC organization, and for a strong General Manager and a purely policy-making five-man Commission, in which all members were to act as co-equals and generalists. The doctrine is contained in numerous writings and internal documents of the early AEC, and it was preached verbally on many occasions.

The effect of this doctrine is then traced by examining actual administrative behavior to see whether it followed the exhortations of the doctrine, and by interviewing AEC persons to discover what motivated their behavior while members of the organization. It is shown that certain parts of the doctrine, especially concerning contractor supervision and decentralization within the agency, became well-known throughout the agency and were accepted as guides to proper administrative behavior by AEC personnel. Other parts of the doctrine appeared to have arisen largely as a protective device, aimed at reassuring persons and organizations (primarily Congressional) of the propriety of AEC administration.

It is next shown that, in 1948 and 1949, certain weaknesses and breakdowns in AEC administration, together with strong outside pressure from the Joint Committee on Atomic Energy and other groups, discredited much of the original doctrine and the administrative behavior which had followed it, and the doctrine came to be preached less often, particularly after several basic personnel changes in 1949 and 1950.

Subsequently, administrative doctrine was not much in evidence in the AEC, although an occasional echo of the terminology could be found. No new administrative doctrine appeared. In part, other more pressing problems attracted attention away from administrative arrangements. In part, the post-1950 leadership of the AEC was not given to philosophizing about administration as was the first Commission, and particularly Chairman Lilienthal.

Finally, the study deals with the question, had the doctrine become internalized within the agency so that it continued to affect administrative behavior, as a kind of pervasive atmosphere, even after the preaching ceased. It is shown that, in general, administrative behavior following 1950 departed from the doctrinal admonitions. Since different patterns of administration did arise, the doctrine can hardly have had a substantial continuing effect.

It may be concluded that the preaching of administrative doctrine can be significantly influential in certain limited situations. The experience of the AEC seems to suggest that doctrine will be most useful and most likely to appear in a fluid setting, such as that which attends creation of a new organization, when patterns of administrative behavior and of external relations have not yet become crystallized. In such a setting, and with leadership adept at using it, administrative doctrine can be important in shaping administrative behavior. 265 pages. $3.45.

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PSYCHOLOGY, GENERAL

METHODS OF ESTIMATION FOR THURSTONE'S ABSOLUTE SCALING MODEL

(L. C. Card No. Mic 58-1078)

Robert Ernest Dear, Ph.D.
University of Washington, 1957

Various problems associated with the application of Thurstone's absolute scaling model are considered in this thesis. Primary consideration is given to the improvement of the statistical estimation of the model's parameters. A review of Thurstone's papers on this scaling procedure revealed that he recognized several deficiencies in his own estimation methods. The absolute scaling model basically deals with the problem of spacing several groups or populations of subjects and items of mental tests along an ability continuum. The major statistical problems that Thurstone did not handle were noted to be: (1) how to estimate the parameters of the model when data have a scaling error component; (2) how to estimate the parameters for all groups simultaneously rather than pairwise; and (3) how to estimate the parameters when the data matrix is incomplete. Each but not all of these three problems were found to have been dealt with by several authors; hence it was felt that it would be desirable to consider systematically and comprehensively all three of these estimation problems.

The aspect of statistical inference which has been of greatest interest in essentially all discussions of the method of absolute scaling is the point estimation of the parameters. In this thesis, first several least squares estimation procedures are developed and then a maximum likelihood procedure is developed which is shown to be better on certain statistical grounds than the least squares procedures. However, it was conjectured that the maximum likelihood procedure appeared to be generally impractical because it would require excessive computations.

To investigate the practicality of using that one of these several estimation procedures which appeared to be computationally most feasible, an extensive illustration was carried out. The procedure that was used was a least squares procedure which allowed an incomplete data matrix. The data employed in this study were the item proportions reported by McNemar for the 1937 revision of the Stanford-Binet scale. Estimates of the absolute scale parameters were computed for these data and were compared with the results of other absolute scaling studies of similar tests. These absolute scale estimates were also compared with rough descriptive statistics which were also computed for McNemar's data.

In view of the results of this application of the absolute scaling method, the underlying model was reappraised with respect to several pertinent psychological considerations and statistical considerations. Recommendations were then made regarding a substantial reformulation of Thurstone's model in the direction of making the model's psychological utility more commensurate with its computational requirements. 105 pages. $2.00.

A FACTOR ANALYSIS OF THE MMPI, APTITUDE TEST DATA AND PERSONAL INFORMATION USING A POPULATION OF CRIMINALS

(Publication No. 25,443)

Bernard Hanes, Ph.D.
The Ohio State University, 1952

Various psychometric, psychomotor, and personal data of fifty inmates of the Ohio State Penitentiary were correlated. The complete list of variables, numbered 01 through 18, which resulted in the correlational matrix are as follows:

01. Age: The ages ranged from 20 to 72 years.

02. Crime: These data were coded as (1) crime against property; (2) crime against people. Sixty-four per cent of the crimes were against property.

03. Occupation: These data were coded as follows, with the per cent of subjects within each classification as indicated.

	Per Cent
1. Professional	6
2. Clerical and Sales	10
3. Service	8
4. Labor—Skilled	14
5. Labor—Unskilled	54
6. Agricultural and related	6

04. Education: Education ranged from 0 to 12th grade.

05. Revised Beta: (1946 Restandardization). A nonverbal intelligence test with age norms built into it.

06. Bennett Mechanical Comprehension Test (Form AA): The mean score was the 66 percentile when compared with "Applicants for Mechanical Helpers" norms.

07. Minnesota Paper Form Board Test (Series MA): The mean score was the 68 percentile when compared with "Miscellaneous Factory Worker" norms.

08. Otis Self Administering Test of Mental Ability: Intermediate Grade, Form A.

Description of the MMPI Scales 08 through 17

09. Hypochondriasis (Hs): A measure of amount of abnormal concern about health. A mean T score of 62 was obtained. All of the T scores in the MMPI scales were obtained by following the manual of directions.

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10. Depression (D): A measure of dejection and feeling of uselessness. A mean T score of 65 was obtained.
11. Hysteria (Hy): A measure of immaturity and conversion symptoms. A mean T score of 68 was obtained.
12. Psychopathic Deviate (Pd): A measure of lack of deep emotional responses and disregard for social mores. A mean T score of 75 was obtained.
13. Interest Scale (Mf): A measure of the tendency of masculinity or femininity of interest pattern. A mean T score of 53 was obtained.
14. Paranoia (Pa): A measure of suspiciousness and oversensitivity. A mean T score of 51 was obtained.
15. Psychasthenia (Pt): A measure of troublesome phobic or compulsive behavior. A mean T score of 64 was obtained.
16. Schizophrenia (Sc): A measure of bizarre and unusual thoughts or behavior. A mean T score of 63 was obtained.
17. Hypomania (Ma): A measure of marked overproductivity in thought and action. A mean T score of 48 was obtained.
18. Psychomotor Test: Subjects were required to correctly sort 64 cards into their respective boxes. The time required to complete this task constituted the score.

The correlational matrix was then subjected to a modified Group Centroid Factor Analysis, which yielded seven factors. A transformation matrix was employed to change the factor loadings from oblique to orthogonal structure. The seven factors were rotated to meaningfulness. The final residual table was secured by the application of Wherry's iterative method for correcting erroneous communality estimates to the residual table which resulted upon extracting the seventh factor.

The seven factors were interpreted by means of profile analysis techniques. Factor A was named Test Taking Attitude. This factor was interpreted as reflecting the overactive criminal of little educational achievement. He achieves high ability test scores but in reality is incapable of actual accomplishment. The high factor loadings are presented below in Table I.

TABLE I

FACTOR A: ROTATED

Variable	Name	Loading
05	Revised Beta Intelligence Test	53
06	Bennett Mechanical Comprehension Test	81
07	Minnesota Paper Form Board	49
08	Otis Intelligence Test	30
12	Psychopathic Deviate	39
17	Hypomania	47

Factor B was labeled General Emotionality because of the high loadings on eight of the MMPI scales. The high loadings are presented in Table II.

TABLE II

FACTOR B: ROTATED

Variable	Name	Loading
10	Depression	43
11	Hysteria	25
12	Psychopathic Deviate	55
13	Interest Scale (Mf)	34
14	Paranoia	66
15	Psychasthenia	80
16	Schizophrenia	74
17	Hypomania	32

Factor C was labeled Mechanical - Compulsive. This factor reflected the kinds of activities young sensitive prisoners of effeminate interests engaged in while in prison. The loadings are presented in Table III below:

TABLE III

FACTOR C: ROTATED

Variable	Name	Loading
06	Bennett Mechanical Comprehension Test	33
07	Minnesota Paper Form Board	28
13	Interest Scale (Mf)	55
17	Hypomania	33

Factor D was labeled Paranoia because of the high loadings on the Interest Scale (Mf), Paranoia and Crime. This factor indicated that effeminate criminals lacking education commit aggressive crimes against people.

Factor E was labeled Unskilled - Antisocial due to the high loadings on the occupational and Pd scales. This factor reflected the anti-social behavior of the criminal of limited occupation and education.

Factor F was labeled Neuroticism due to the high loadings on the hypochondriacal, hysterical, and depressive scales of the MMPI. This factor reflected neurotic symptoms such as tenseness, insecurity, and sensitivity in criminals.

Factor G was labeled the Intelligence Factor due to the high loadings shown in Table IV.

TABLE IV

FACTOR G: ROTATED

Variable	Name	Loading
04	Education	69
05	Beta Intelligence Test	42
06	Bennett Mechanical Comprehension Test	25
07	Minnesota Paper Form Board	72
08	Otis Intelligence Test	74

High scores on this factor were interpreted to mean that the more intelligent criminal makes relatively good adjustment in prison.

At least six of these factors resembled those of other

The items following each abstract are: the number of manuscript pages in the dissertation, its cost on microfilm, and the Library of Congress card number. Enlargements 5-1/2 x 8-1/2 inches, 4 cents per page. No postage is charged if check or money order accompanies order.

workers. The study did not produce results at variance with previous studies, and the consistency between this and other studies is taken as evidence that the method is sufficiently stable to justify its use as a basis for descriptive procedures at the Ohio Penitentiary.

27 pages. $2.00. Mic 58-4843

Abstract published by special arrangement with The Ohio State University.

THE EFFECTS OF A STIMULUS OF 100,000 CYCLES PER SECOND UPON CERTAIN PHYSIOLOGICAL AND PSYCHOLOGICAL FUNCTIONING OF 7TH AND 8TH GRADE BOYS

(L. C. Card No. Mic 58-637)

Charles S. Maniscola, Ph.D.
New York University, 1957

Chairman: Professor John G. Rockwell

This investigation measured the reactions of sixty-two seventh and eighth grade boys before and after they were presented with an inaudible stimulus of 100,000 cps for five minutes. Fingertip, ear and nose temperature, immediate recall, and steadiness, were measured by U.M.A. Thermocouple, a Digit Span, and a Lawton Steadiness Apparatus, respectively. These measures were compared to those obtained from thirty-three control subjects who were similarly tested, receiving no stimulus.

Each subject was tested under similar noise and atmospheric conditions measured by a General Radio 1555-A Sound-Survey Motor and a Taylor Meteorograph. The stimulus was produced by a Hewlett-Packard 200-C Oscillator and an Altec 270-B Microphone.

Each subject was previously screened by a physical examination, a chest x-ray, by hemoglobin, urinalysis, and audiometer tests, a minimum I.Q., and a survey for mental disorder. Afterward, three physical fitness tests were taken by each subject. Thereupon, every third boy was assigned as a control subject.

The physical fitness scores of control and experimental subjects were converted into T-Scores, then into composite scores of physical efficiency. The physical efficiency scores of each group were treated to determine statistical similarity. No statistically significant differences were found between both groups in T-Score and Composite Score Means on the basis of Pull Up, Seventy Yard Dash, and Standing Broad Jump.

Comparisons were made between measures of experimental and control subjects by testing for the significance of the difference between temperature, steadiness, and digit span means. No significant differences were found from trial to trial with the exception of thermocouple temperatures for the right and left ear on both trials for both groups. Here, the significance was greater than the .01 level. On the first and second trials for the control subjects in the Digit Span Forward and Reversed, respectively, the significance was greater than the .01 level. The fact that atypical ear temperature reaction occurred before as well as after the experimental stimulus indicated that the reactions were not due to the experimental stimulus. Digit Span reactions were significantly different in the measures of control subjects indicating that the stimulus was not responsible for the significant differences.

No significant differences were found in temperature, steadiness, and digit span measures when correlation coefficients were tested for significant differences on first and second trial measures for both groups. The fact that correlations ranged quite low suggest that some of the subjects were differentially reactive.

Analysis of comparisons made between extreme cases taken from experimental and control subjects brought out atypical measures between first and second trials with a probability range which varied from .01 to .82. This indicated further that factors other than the stimulus, such as those within the individual, might have been the source of these results. Such reactions might have been influenced by existing borderline nutritional deficiency or imbalance, and/or psychoemotional states.

Matching groups and comparing them on the most consistent reaction, that of steadiness, showed no significant differences between groups on either the first or second trial. A three-part analysis of variance also showed no statistically significant differences.

The conclusion that may be drawn from the results of this study is that no statistically significant differences were found between an experimental and control group of "normal" seventh and eighth grade boys in thermocouple temperatures, immediate recall for digits, and steadiness that were due to an inaudible stimulus of 100,000 cps for five minutes. The design of this research might be useful at higher frequencies and at varying duration when applied to studies concerned with girls, pregnant women, hysterical personalities, cell cultures, or white mice.

134 pages. $2.00.

A DISPERSION ANALYSIS OF THE INTERESTS OF 115 OCCUPATIONAL AND REFERENCE GROUPS

(L. C. Card No. Mic 58-1133)

Warren Theodore Norman, Ph.D.
University of Minnesota, 1957

Adviser: Kenneth E. Clark

Five lines of development including (1) psychometric studies of interest, (2) unidimensional versus factorially complex assessment approaches, (3) concept and theory construction, (4) dispersion analysis methods, and (5) recent advances in high-speed electronic computing were briefly described and the relevance of each to the present study was discussed.

An analysis of the patterns of interest of 115 occupational and reference groups was undertaken. The Minnesota Vocational Interest Inventory answer sheets for each of 6,824 subjects were scored on nine homogeneous keys and processed for input to the Remington Rand 1103 Scientific computer. The analysis yielded the means and standard deviations for each group on all keys, the pooled intragroup dispersion matrix and its inverse, the full set of intergroup distances, the canonical roots and vectors of the pooled between-group matrix, and the coordinates of each group's centroid on all nine canonical variables.

In addition, certain tests of assumptions underlying the model were performed and a cluster analysis of the groups in terms of their mutual distances was done. Finally, a geometric representation of the distribution of the groups based on their patterns of interest was presented. This was accomplished by plotting the centroid of each group on the two most variance-absorbing pairs of canonical axes.

Those groups that were found to cluster on the basis of the generalized distance analysis also showed nearly congruent profiles across the set of keys. Similarly, both the cluster analysis based on the generalized intergroup distances and the plots of the group centroids on the best two pairs of canonical variables distributed the groups in an intuitively reasonable fashion throughout the space. Occupational groups which engage in similar activities were found either to cluster together or to lie in the immediate vicinity of a related cluster.

Groups with patently divergent interests were found to be easily separated. In addition, the arrangement of the clusters through the space was systematic and regular when viewed in terms of the similarities in the interests of the constituent groups.

In general, therefore, the dispersion analysis model employed yields results which summarize the relations among the groups studied in a sensible and meaningful way. In addition, the use of the interpretable and minimally correlated homogeneous keys together with the results of the canonical reduction analysis provides a basis for identifying the differentiating dimensions of measured interest and their number.

It was found that about 80 per cent of the between-group variance can be accounted for by the four best linear functions, and the best six out of nine extract almost 92 per cent of the intergroup information. Thus fewer than half the total number of canonical variates are needed to effect a fairly accurate reconstruction of the space.

Several subsequent studies are warranted by these results. First, a cross-validation on a new set of samples from the same populations using the same keys would provide needed information on the instability of the space due to sampling error. At present only a minute amount of indirect evidence is available on this point, although it appears to be slight. Secondly, estimates of the accuracy of classification based on the discriminant functions here computed for an independent set of samples would be valuable to persons interested in the application of these results in practical settings. Thirdly, it would be interesting to observe what modifications, if any, would occur in the distribution of these groups when a comparable set of empirical rather than homogeneous keys were employed in a similar analysis. Until such studies are completed, the results of the present investigation must be viewed as tentative and are presented here as such. 333 pages. $4.30.

THE GENESIS OF THE AUTHORITARIAN PERSONALITY

(L. C. Card No. Mic 58-989)

Sohan Lal Sharma, Ph.D.
University of Michigan, 1957

This research investigated the genesis and some of the behavioral correlates of the authoritarian personality as described by Frenkle-Brunswik. Based upon a review of the literature and a re-examination of the psychoanalytic theory of personality, the following hypotheses were formulated for test:

1) a significant positive relationship exists between authoritarianism and conflict at three stages of psychosexual development, a) the oral dependent, b) anal retentive and c) oedipal stages.

2) a significant positive relationship exists between authoritarianism and difficulty in establishing an adequate sexual identity.

3) authoritarians prefer projection as a defense against oral dependent conflict.

4) authoritarians prefer reaction formation as a defense against anal retentive conflict.

5) individuals with both oral dependent and oedipal conflict would be more prone to authoritarianism than individuals in whom one or both was absent.

Subjects included 64 undergraduates (32 male, 32 female) in a course in psychological statistics at the University of Michigan. They were administered the following tests: the California Predisposition to Fascism (F) Scale to measure authoritarianism, the Blacky Pictures and Defense Preference Inventory (D.P.I.) to measure psychosexual conflict and defense, scales from the California Psychological Inventory measuring Tolerance, Flexibility and Self-Acceptance, a Negro Attitude scale to measure anti-Negro prejudice, and the Einstellung Arithmetic test to measure problem-solving rigidity.

In order to analyze the results statistically, the distribution of each variable was divided at its median, and the degree of association between variables was determined by Kendall's Tau. All significant results and trends were cross-validated by randomly splitting the group, using the first half to establish trends, and the second half to cross validate. Hypotheses 1b, 1c, and 5 were clearly confirmed. These results demonstrate a relationship between high authoritarianism and anal retentive conflict, high authoritarianism and oedipal conflict, and indicate that the existence of both oral dependent and oedipal conflict strongly predispose the individual to the development of authoritarianism. Hypotheses 1a, and 4, regarding the relationship between high authoritarianism and oral dependent conflict, and the use of reaction formation against anal retentive conflict by authoritarians, were not clearly confirmed, but the results showed a clear trend in the expected direction. Only hypotheses 2 and 3, regarding inadequate sexual identification and the use of projection against oral dependent conflict, failed to find any support in the results.

A series of exploratory tests were also carried out. These demonstrate that authoritarians show greater masturbation guilt than non-authoritarians, and that authoritarian females have lower Self-acceptance, Tolerance, and higher anti-Negro prejudice than the authoritarian males.

Based upon these findings and a reconsideration of previous researches, an attempt was made to provide an integrated picture of the development of the authoritarian personality. Essential factors in the development of authoritarianism are a) harsh, moralistic and socially climbing parents, b) conflict at the oral and the anal stage, c) primitive identification with punitive parents, d) conflict

at oedipal stage, and e) displacement of one's negative impulses onto unacceptable out-group members. The authoritarian attempts to cope with his conflicts by developing reaction-formation against anal conflicts, incorporating various rigid parental attitudes, and displacing his negative impulses onto members of out-groups.

The major contributions of the dissertation were a) experimental confirmation of Frenkel-Brunswik's speculations concerning the role of anal and oedipal conflict in authoritarianism, b) suggestive evidence concerning the importance of masturbation guilt in authoritarianism, and a suggestion concerning the role of oral conflict; c) the suggestion that authoritarianism, itself, may serve as a defense against dependency needs, and d) the establishment of certain important behavioral correlates of, and sex differences in, the genesis and manifestation of authoritarianism.

Finally, the implications for theory and for the research were discussed. 113 pages. $2.00.

RELATIONS BETWEEN NORMATIVE AND IPSATIVE MEASURES OF PERSONALITY

(L. C. Card No. Mic 58-1101)

Calvin Edward Wright, Ph.D.
University of Washington, 1957

Normative, normative ipsative, and empirically ipsative measures of personality were obtained from a group of college students and compared with respect to their means, reliabilities, correlations, intercorrelations, and factor structures. These particular measures were chosen so that the influence of social desirability could also be investigated. The empirically ipsative scores were obtained from the Edwards Personal Preference Schedule, a personality inventory purporting to measure fifteen personality needs where items of approximately equal social desirability scale values have been paired to minimize the influence of this variable. Interactive scores were obtained by administering the individual statements of the EPPS in rating scale form, where the influence of social desirability was uncontrolled. The interactive scores were converted to normative scores by standardizing each variable to a mean of fifty and a standard deviation of ten. The normative scores were then mathematically ipsatized over people to produce the normative ipsative measures, where the sum of each individual's scores was a constant.

The roles of both the ipsatization process and the social desirability variable as they affected the results were investigated, the influence of these factors and others were discussed, and the results were compared with other studies. Implications and suggestions for further research were also mentioned. 158 pages. $2.10

PSYCHOLOGY, CLINICAL

CONFLICT IN SEX IDENTIFICATION IN BOYS

(L. C. Card No. Mic 58-1021)

Nathan Altucher, Ph.D.
University of Michigan, 1957

This is a study of sex identification and conflict over sex identification in adolescent boys. Sex identification was defined as the attitudes and behaviors which are culturally sex linked. At first all children presumably identify with their mothers. Boys learn the masculine role as they develop and must integrate it with their previously learned femininity. However, for some, the earlier feminine tendencies remain predominant on either a conscious or unconscious level. In this study these boys were defined as being in conflict.

We wished to study some factors which might be related to the development of sex identification and conflict in sex identification such as the child's perceptions in three areas of parental behavior: dominance in making decisions, parental role similarity, and the type of discipline used in punishing the child. We also related one aspect of current functioning to sex identification, motivation for achievement.

Our sample consisted of 211 seventh and eighth grade boys who met the following criteria: white, Christian, within one year of the median age for their grade, who had attained a reading level no more than two years below their grade level, living with their biological parents, with both parents having been born in the United States.

In the procedure used to measure need achievement, the subjects wrote stories to standard pictures, three administered before and three after an arousal procedure designed to increase achievement motivation.

Following this, the subjects filled out a booklet containing the following: The Franck Drawing Completion Test to measure unconscious sex identification, a conscious sex identification test designed for this age group, and measures of dominance, role differentiation and discipline type.

We predicted that for the conflicted children the mother would be dominant, while for the unconflicted ones the father would be. This was confirmed for dominance in setting limits for the child but not for dominance in making family decisions or gratifying the child. We also correctly predicted that the conflicted children perceive their parents' roles as being more similar than the non-conflicted children do, and that their parents' roles deviate more from the modal parental role. Our prediction that the parents of the conflicted boys would show more role reversals than the parents of the non-conflicted boys was not confirmed.

Our prediction that sex identification was related to parental discipline type was not confirmed. We observed that conscious sex identification was related to dominance in setting limits and that unconscious identification was related to perception of similarity in parental roles and to role reversals. Using the extreme groups, we found that unconsciously feminine boys obtained higher need achievement scores under neutral conditions than either the unconsciously masculine-feminine boys or the unconsciously masculine boys. After arousal no group changed significantly.

We also made predictions about the need achievement scores of specific subgroups, the FFs, FMs and Mf-Mfs, the first letter signifying unconscious sex identification and the second one conscious sex identification. We predicted that under neutral conditions both the FFs and FMs score higher than the Mf-Mfs. Only the first was borne out. Our prediction that both the FMs and Mf-Mfs would increase their scores after arousal was not confirmed.

Two general conclusions can be drawn from this study. First, the perceptions of parental behavior of boys with conflict in sex identification differ, in some respects from the perceptions of parental behavior of non-conflicted boys. Second, conscious and unconscious sex identification are not related to the same aspects of parents' behavior, as perceived by boys. 129 pages. $2.00.

A STUDY OF THE RELATIONSHIP BETWEEN SOCIAL DESIRABILITY AS A PSYCHOLOGICAL VARIABLE AND LEARNING PERFORMANCE IN A COMPLEX VERBAL TASK

(L. C. Card No. Mic 58-1074)

Philip Kier Brown, Ph.D.
University of Washington, 1957

The concept of social desirability, as a psychological variable, has at least two aspects. First, social desirability, as a property of the items, has been found to influence test responses to personality scales. Second, social desirability as measured by the Edwards SD scale, is an individual differences variable which is assumed to measure drive level in the sense that Taylor and Spence conceive the Taylor MAS to measure drive level. This assumption is based on the very high correlation between the two scales. On the basis of the assumption that the SD scale measures drive level, it is possible to formulate predictions of performance in a complex verbal learning task. A test of such predictions would throw light on the meaning of the SD scale, the Taylor MAS and on conflicting results of previous studies. Two subsidiary variables are also evaluated. There was reason to believe that the sex variable, and the variable inherent in sorting items into "like me" and "not like me" categories were related to learning performance in a complex verbal task.

In order to investigate the above problems, an analysis of variance design was formulated. Four groups of ten subjects each, differing in SD score and sex were obtained. By using items of high and low scale value that had been sorted into "like me" and "not like me" categories by the subjects, a complex learning task was set up. The subjects were required to memorize sixteen statements paired with nonsense syllables, using a modified paired-associates learning method. This made it possible to obtain measures of learning performance by which to evaluate the relationship between both aspects of social desirability, sex, and the "like me" "not like me" variables and learning performance.

The question of whether social desirability as a property of the items could influence learning performance was answered in the affirmative. The "like me" "not like me" variable unconfounded from the social desirability variable was found to have no significant relationship to any measure of learning. Mean scores of learning performance between males and females failed to differ significantly. The performance of high SD scoring males did not differ significantly from that of low SD scoring males. However, the high SD scoring females differed significantly from the low SD scoring females on every measure of learning performance and recall.

The theoretical predictions of the Taylor-Spence group were not substantiated for the performance of the males, but held up very well for the two female groups. In effect, the "high drive" females did not perform as well as the "low drive" females in a complex verbal task.

Interpreting the results in Edwards' sense, the high SD females "tried to look good" in a learning situation, and succeeded, while the low SD females did not try to look good, and did not learn as well.

Certain implications of the present study were presented as important for future research. In particular, the interaction of "E's sex x S's sex x anxiety score" was felt to be potentially meaningful. 84 pages. $2.00.

THE RELATIONSHIP OF PERSONALITY TO ORAL CONDITIONS IN CHILDREN: AN EVALUATION BY MEANS OF THE RORSCHACH AND THE BLACKY TEST

(L. C. Card No. Mic 58-647)

Rhoda K. Burnham, Ph.D.
New York University, 1957

An investigation was made of the hypothesis that significant personality differences exist between children with disturbed dental conditions and those with little or no dental disease. Also examined was the hypothesis that children with organic mouth disorders would manifest more orality fixation than children with normal dental conditions. The hypothesis that children suffering from a high degree of dental disease would manifest more personality disturbance than children with healthy dental conditions was also investigated. The study is significant as a contribution to the field of psychosomatic dentistry.

Two groups of children ranging in age from six to ten were selected. Each group consisted of twenty-five children (fifteen boys and ten girls) who were equated in terms of age, sex, and I.Q. All subjects had a minimum I.Q. of eighty. The experimental group was comprised of children with a caries index of more than twenty as determined by the modified D.F.M.* scale; and the control group was made up of children with a D.F.M.* score of less than ten. This study was limited to children who had enjoyed an adequate diet, and had suffered no severe physical or mental illnesses. Objective methods included case histories, questionnaires for parents, Stanford Binet Intelligence tests, and judgments of overt test behavior. The projective methods consisted of the Blacky Pictures and the Rorschach.

Personality differences were scored according to a modified form of Fine's scoring scheme, clinical observations, and Rorschach test signs. Orality was scored from a list of verbal responses devised for the purposes of this study. The data were analyzed statistically and qualitatively.

Comparison of group results reveals provocative trends rather than conclusive results. In all but one instance, where significant differences are found, the experimental group shows signs of more personality disturbance than the controls. The experimental group indicates somewhat more disturbance both in interpersonal relationships and emotional reactivity. The inability of the experimental subjects to cope adequately with feelings of hostility and frustration indicates a lack of control and ego strength. They seem less able to meet successfully the demands of familial relationships, and appear to function less effectively in a given situation.

The control group, on the other hand, seems better able to adjust to the demands of familial relationships, and seems able to function more appropriately to a given situation. The difference between the groups is basically a difference in function.

However, the significant differences that were found do not present a definitive picture. Although there were no conclusive findings of the relationship between dental disease and personality, there were provocative trends in the direction of such a relationship.

Additional researches are recommended to investigate the following: orality differences made by a study of the attitudes of subjects towards dental disturbances, of the overt manifestations of orality, and of character types; and emotional life and interpersonal relationships (with emphasis on the sibling relationship) limited to the ten year old age group. It is suggested that in any such future studies a narrower age range, and a larger sampling, be considered. 160 pages. $2.10.

*Decayed, filled, missing.

THE INFLUENCE OF THE SEX OF THE THERAPIST AND OF THE CO-THERAPIST TECHNIQUE IN GROUP PSYCHOTHERAPY WITH BOYS: AN INVESTIGATION OF THE EFFECTIVENESS OF GROUP PSYCHOTHERAPY WITH EIGHTH GRADE, BEHAVIOR-PROBLEM BOYS, COMPARING RESULTS ACHIEVED BY A MALE THERAPIST, BY A FEMALE THERAPIST, AND BY THE TWO THERAPISTS IN COMBINATION

(L. C. Card No. Mic 58-660)

Marvin Daniels, Ph.D.
New York University, 1957

Chairman: Professor Brian E. Tomlinson

The purpose of this study was to evaluate differences in progress made by groups of behavior-problem boys in school who were provided with group psychotherapy experiences under the guidance of a male therapist alone (M Group), a female therapist alone (F Group), and by the two therapists in combination (MF Group). A control group (C Group), used for comparison, followed its usual school regimen without such group discussions.

The subjects were twenty-four eighth grade boys of middle or upper-middle socio-economic status in a public junior high school, assigned at random to one of the four aforementioned groups. Therapy groups engaged in twenty weekly periods of free discussion, lasting forty-five minutes each.

Pre- and post-therapy, measurements were undertaken of the subjects' I.Q. scores; overt behavior; achievement levels in reading comprehension and arithmetic; conscious attitude toward school. Two psychologists also rated changes in the degree of emotional disturbance found in certain of the subjects' attitudes, based upon the boys' responses in two projective tests, the Modified Sacks Sentence Completion Test and the Figure-Drawing-and-Tell-a-Story Test. Intra-group comparisons of pre- and post-therapy measurements were made with the t test for correlated samples, and inter-group comparisons with the non-parametric Median Test.

According to teachers' ratings, the C Group lost interest in school work to a significant degree. Apparently, too, its facility in arithmetic suffered as a consequence. No improvements were noted in any area.

The M Group exhibited improvement socially and in behavior involving intellectual, physical, social and emotional characteristics. No deterioration occurred anywhere.

The F Group showed improvement in social behavior, attitude toward male peers, self-confidence, faith in the future, acceptance of a male sexual role. It was rated as manifesting a trend toward less emotional disturbance in general. No deterioration occurred in this group either.

The MF Group showed improvement in defiance to discipline, overactivity, problem behavior as a whole and social behavior. Negative findings, however, outweighed these apparent behavioral gains. These children emerged more hostile toward school, more anxious, less confident in themselves and the future, more reluctant to adopt a male sexual role, and with a trend toward more emotional disturbance in general.

Based upon the quantitative and qualitative results, the investigator drew the following main conclusions which are tentative and apply only to the population and techniques employed in the study:

1. Problem-behavior, eighth grade boys are not likely to improve in the space of a school year if left to their own devices. If anything, they are likely to deteriorate.

2. The co-therapist technique is possibly injurious to the psychological health of young adolescent boys although it may effect immediate surface improvement through an elevation of the anxiety level which leads, in turn, to subdued classroom behavior. Heightened anxiety is attributed to replication of the family constellation with its Oedipal overtones.

3. Discussion groups led by a male or female separately can be useful in promoting positive behavioral and (or) psychological transformations with no ill effects.

4. Boys at this age react in considerably different ways to group therapists of different sexes. More negative transference to the male (father figure) is likely to emerge; positive transference to the female (mother figure) appears quickly and tends to remain intact. This finding is consonant with Freudian theory and the implication is that therapists of different sexes may expect to encounter different problems in the early stages of group psychotherapy. The male therapist will meet with considerable transference resistance and hyperaggression. The female will find herself contending with extensive (sibling) competition for her attention and approval.

281 pages. $3.65.

ADAPTIVE MECHANISMS OF A SELECTED GROUP OF EIGHT YEAR OLD CHILDREN AS RELATED TO THEIR CONCEPTS OF PARENTS: AN INVESTIGATION OF THE RELATIONSHIP BETWEEN VARIATIONS IN CHILDREN'S ADAPTIVE MECHANISMS AND VARIATIONS IN CHILDREN'S CONCEPTS OF PARENTS, AND OF SEX DIFFERENCES IN THIS RELATIONSHIP

(L. C. Card No. Mic 58-632)

June T. Harris, Ph.D.
New York University, 1957

This study was designed to investigate, in a selected group of eight year old children, the relationship between variations in adaptive mechanisms and variations in concepts of parents, together with sex differences in these two variables and in their relationship. The procedure consisted of selecting adaptive mechanisms and concepts of parents significant for eight year old children, defining these variables in operational terms, and studying the relationship between them as thus operationally defined, keeping the data for boys and girls separate in order to allow for the investigation of possible sex differences.

The subjects consisted of 50 eight year old children, selected on the basis of special criteria and evenly divided as to sex. The 25 boys and 25 girls were carefully equated for all the criteria.

The selected adaptive mechanisms were aggression and withdrawal. They were operationally defined in terms of objective ratings by teachers. By obtaining the ratings of three different teachers it was possible to estimate which, if either, of these two mechanisms was generally characteristic of the behavior of the particular child and to classify him accordingly. Sex differences in aggression and withdrawal were determined statistically.

In studying the children's concepts of parents, an attempt was made to reach unconscious as well as conscious levels of experience. To this end projective techniques (Rorschach and Human Figure Drawings) were employed as well as a direct interview. These data were evaluated by three clinical psychologists, according to whose pooled opinions the children were classified with respect to their varying concepts of parents. Ratings were made of the children's concepts of the respective parents as sources of satisfaction of needs or drives, and as sources of frustration of needs or drives. Sex differences in the concepts of parents were determined statistically.

The relationships of the operationally defined adaptive mechanisms and operationally defined parent concepts were then determined statistically. Sex differences in these relationships were analyzed.

The findings were as follows.

Aggression and withdrawal were found to be significant adaptive mechanisms, and the concepts of the parents as sources of satisfaction of needs or drives and as sources of frustration of needs or drives (at both conscious and unconscious levels) were found to be significant concepts of parents, that could be operationally defined and measured for these eight year old children.

Ratings of the girls indicated a higher degree of withdrawal than those of the boys, the difference being significant at the .02 level of confidence.

Ratings of the boys in aggression tended to be higher than those of the girls. These differences were not statistically significant.

Ratings of the concepts of parents showed a trend for the girls to have higher average ratings for concepts associated with satisfaction of needs or drives, and the boys to have higher average ratings for concepts associated with frustration of needs or drives. The difference in favor of the girls in the concept Unconscious Satisfaction Mother was significant at the .05 level. The difference in favor of the boys in the concept Unconscious Frustration Mother was significant at the .02 level.

Average ratings for withdrawn children tended to be higher than those of aggressive children for concepts associated with satisfaction from parents.

Average ratings for aggressive children tended to be higher in concepts of parents associated with frustration. The difference in favor of the aggressive children for the concept Unconscious Frustration Mother was significant at the .05 level.

These findings were considered of significance in relation to theories of personality development, and also in relation to educational and therapeutic programs for children. 119 pages. $2.00.

THE EDWARDS PERSONAL PREFERENCE SCHEDULE AND ACADEMIC ACHIEVEMENT

(L. C. Card No. Mic 58-1086)

Shirley Louise Klett, Ph.D.
University of Washington, 1957

The objective of the present study was to explore the relationships between the scores of the Edwards Personal Preference Schedule (EPPS) and various aspects of academic achievement. Four hundred students from the class of 1955 were obtained from two King County High Schools to constitute the major group for study with a similar group of 425 students from the class of 1956 used for replication purposes. The sexes were studied separately. Multiple correlations were derived to evaluate the efficiency of the EPPS in a predictive battery and to determine which variables would emerge as the most important contributors to any increment in prediction of GPA. Cumulative GPA was used as the criterion, and the predictive variables included the fifteen scores on the EPPS, the EPPS consistency score, age, socio-economic status as obtained from father's occupation, and IQ score. The personality characteristics of over- and under-achievers, defined in terms of the discrepancy between actual achievement and that predicted from intelligence test score, were also investigated. Finally, partial correlations were computed so that the strength of the relationship between GPA and each of the EPPS variables could be seen in the absence of the effects of IQ differences. The results of these various approaches to the objective were as follows:

1. The inclusion of EPPS variables in a predictive battery yielded multiple correlations significantly higher than the single largest validity coefficient (IQ), but when the beta weights were applied to scores of independent, randomly drawn subgroups of the same class of high school students, the increment in prediction efficiency of the multiple correlations over IQ proved to be neither practically nor statistically significant. However, when the beta weights based upon the total class of 1955 were applied to the scores of the class of 1956, the multiple correlations

both for boys and girls continued to contribute significantly to prediction over IQ alone. Further work will have to be done to establish the extent of the contribution that the EPPS can make to the prediction of academic achievement.

2. Although the role of the EPPS in the prediction of GPA was not impressive or unequivocal, considerable information was yielded about the relative importance of particular variables in relation to academic achievement.

3. A study of over- and underachievers performance on the EPPS revealed significant mean differences on six of the sixteen scales. These differences were shown to be independent of IQ differences and sex and were stable differences as shown by replication of the design.

4. A number of EPPS scales were significantly related to GPA after IQ had been partialed out.

5. Striking consistency was revealed in all of these analyses in respect to the particular variables related to achievement. Overachievers were found to have higher scores on achievement, dominance and endurance and lower scores on heterosexuality, autonomy and aggression. In the regression equations these six variables carried algebraic signs appropriate to these findings and, in addition, dominance and achievement were shown to be important and consistent contributors to the multiple correlation. The partial correlations further corroborated the importance of these variables. 83 pages. $2.00.

AN INVESTIGATION OF SEMANTIC DIFFERENCES AMONG, AND THE INFERENTIAL PROCESSES OF PSYCHIATRISTS, PSYCHOLOGISTS AND PSYCHIATRIC SOCIAL WORKERS

(L. C. Card No. Mic 58-1122)

Maurice Korman, Ph.D.
University of Minnesota, 1957

Adviser: Dr. William Schofield

The consistently poor showing of clinicians in large scale global assessment studies should lead to increasing concern over the bias introduced by constant processes in the assessor, such as his implicit personality theories, his reliance upon the connotative meaning of key terms, his idiosyncratic use of concepts and the even more personal and imprecise inferences drawn therefrom.

In this study four groups consisting of ten psychiatric residents, ten psychiatric social workers, ten Ph.D. psychologists and ten psychology trainees rated 20 descriptive, 11 diagnostic and nine therapeutic concepts on nine scales of Osgood's semantic differential. The concepts chosen were among the more frequently used terms of an empirically derived pool; the scales were selected after their relevance for this type of concept had been demonstrated. At a subsequent time, the subjects sorted the same forty items from "most true" to "least true" of a patient about whom they were given a certain amount of information.

Four major types of analyses were performed: (1) a study of intergroup differences, including differences in the average meaningfulness of these concepts, in the average degree of connotative similarity assigned to pairs of concepts and in mean semantic structures based on the distances D between concepts; (2) an analysis of the clustering of terms relating to therapy for a grcup of 20 psychologists; (3) an investigation of the relationship of implicit personality theories as defined by semantic structures and the likelihood of certain inferences being drawn about a patient; (4) an evaluation of the concepts used in this study with particular references to their relative meaningfulness and factorial loadings.

Major results and conclusions were as follows:

(1) Significant intergroup differences in semantic structures and in degree of connotative similarity assigned to pairs of concepts exist between psychologists (regardless of level of experience) and social workers, with psychiatrists maintaining a mediating position between these two disciplines. Social workers also assigned less meaningfulness to nine of the forty concepts than did psychiatrists and/or psychologists. It is suggested that social workers make fewer discriminations between the connotative meaning of psychiatric and psychologic terms.

(2) An intensive analysis of the interrelationships between nine terms relating to therapy for 20 psychologists suggests the existence of three clusters of terms: (a) Directive Psychotherapy, Commitment and EST; (b) Psychotherapy, Uncovering Psychotherapy and Group Psychotherapy and (c) Reassurance, Supportive Psychotherapy and Tranquilizing Drugs. Clusters #1 and #3 were furthest apart in semantic space, with cluster #2 nearly equidistant from them. These clusters (a) can be said to represent the degree of equivalence and interchangeability of the terms in the cluster and (b) are suggestive of situations in clinical practice in which the terms of one cluster would be more applicable than those of another. Such clusterings can be presented as providing an insight into the implicit personality theories of clinicians.

(3) No relationship was found between the four experimental groups' semantic structures and parallel values in their mean Q-sorts. Moreover, another methodological approach which bypassed some of the limitations of the Q-sort yielded equally negative results. This study suggests that the connotative similarity between any two psychiatric or psychologic terms does not enhance the probability of the second being inferred once the first term has been applied.

(4) Semantic differential ratings yield useful measures of meaningfulness and a helpful functional dictionary of connotative meaning can be devised.

159 pages. $2.10.

PSYCHODYNAMIC FACTORS ASSOCIATED WITH FUNCTIONAL INFERTILITY IN MARRIED COUPLES: A COMPARATIVE STUDY OF PSYCHOLOGICAL FACTORS IN A GROUP OF FERTILE MARRIED COUPLES AND A GROUP OF INFERTILE MARRIED COUPLES WITHOUT A MEDICAL BASIS FOR THEIR CONDITION

(L. C. Card No. Mic 58-663)

Morris Laitman, Ph.D.
New York University, 1957

Chairman: Professor Brian E. Tomlinson

This study investigated certain psychodynamic factors in married couples to determine the fruitfulness of a psychological approach to infertility.

The study was limited to thirty couples, and was composed of two groups: a group of fifteen couples who were diagnosed as being functionally infertile by medical examination and a group of fifteen fertile couples awaiting the birth of their first child.

Both groups were equated for age, number of school years completed, economic status, and number of years of marriage. All subjects were administered a battery of psychological tests consisting of the Rorschach, Thematic Apperception Test, and an interview. The psychological protocols for each couple were submitted to three clinical psychologists who independently rated each subject for 78 personality variables. They also rated each couple on four psychodynamic factors existing between each husband and wife.

Reliability of the judgments was determined and all variables for which there were significant differences between the judges' ratings were excluded from further statistical examination. The remaining variables were then subjected to a chi-square test in which the functionally infertile and fertile groups were compared with each other along each variable.

The psychological examinations of three randomly selected functionally infertile couples and three randomly selected fertile couples were also intensively studied, utilizing an holistic approach. The results of this approach were compared with the results obtained by the statistical method.

Results

1. The hypotheses that the functionally infertile group of couples would demonstrate greater hostility toward the mate, greater unconscious fear of the responsibility of parenthood, and a greater disparity in the self sufficiency-dependency and dominance-submission relationships existing between husband and wife than would the fertile group of couples were not supported by the statistical results.

2. The hypothesis predicting that the functionally infertile group of couples would differ significantly from the fertile group of couples in attitudes toward significant authority figures, acceptance of sexual role, and certain other interpersonal relationships including the self sufficiency-dependency and dominance-submission relationships existing between husband and wife, was, on the whole, not supported by the statistical results.

3. The functionally infertile male group is differentiated from the fertile male group in several respects. The functionally infertile male group views mother as an emotionally stronger, wiser, better person than father, has more fear of mother's censure, is less actively defiant of and resistant to direction and advice from authority and obeys the wishes of others more than the fertile male group.

4. The functionally infertile female group is differentiated from the fertile female group in several respects. They regard father as being more punitive, are less actively striving to be like mother, are less actively striving to be like father and look more to others for encouragement and emotional support than the fertile female group.

5. The analyses of the psychological protocols of the three functionally infertile couples indicate that although either partner may have a greater abundance of psychodynamic characteristics that contribute to the marital discord, the infertility is a result of the interaction of the two partners. It would follow that functional infertility is a conjugal phenomenon and can best be assessed by a thorough exploration of each partner's personality structure and the interaction of the two.

6. Although the analyses of the psychological protocols of the three randomly selected functionally infertile couples reinforce the contention that the somatic effects of psychodynamic factors may result in an inhibition of fertility, the similarity between the psychological test results of one fertile couple and the psychological results of all three functionally infertile couples selected randomly for intensive study infers that in an investigation of the psychodynamic factors in functional infertility, a primary constitutional susceptibility must be taken for granted., 227 pages. $2.95.

A STUDY OF THE ORGANIZATION OF SELF-PERCEPTS THROUGH THEIR SUSCEPTIBILITY TO CHANGE

(L. C. Card No. Mic 58-946)

Julia Bader Leonard, Ph.D.
University of Michigan, 1957

The purposes of this study were: (1) to investigate the stability of four presumed levels of genetic development of self-percepts over a short period of time, (2) to determine whether the self-perceptual organization as measured was different for "normal" and neurotic subjects, (3) to determine whether the various levels of self-percepts were equally susceptible to change under conditions oriented toward producing change in the personality, and (4) to determine whether the temporal order of development of self-percepts affects the kinds of changes that take place.

A control group of 35 students in an introductory psychology course and an experimental group of 20 outpatients in a psychiatric clinic were evaluated. A 120 item test was devised which consisted of pairs of items on which these subjects rated how they felt about themselves and how others felt about themselves. The items were designed to tap four aspects of the self-percept, based on a presumed temporal order of development, these being, respectively, the body, familial, extra-familial, and societal images. Ratings by the subjects were made on a four-point continuum. Scores for self-rating and rating of

others were the sums of numerical values marked from one to four. An additional scoring category was the sum of the discrepancies between the self-rating and the rating of others for each item. Both groups were tested at the beginning of the experimental period. The control group was retested after a two month interval and the experimental group, after a three month interval of psychotherapy. Comparison of test-retest results was made by the use of Pearson correlation coefficients, and test of significance, by Fisher's t.

Test-retest correlations of the three scoring categories on the four levels for both control and experimental groups ranged from .69 to .93 with one exception. These measures of stability are similar to those reported in the literature. In a comparison of the control and experimental groups, the latter group was found to have higher test-retest correlations than the control group, the difference significant on three levels. Furthermore, on the initial test scores, the experimental group showed significantly lower relationships between the self-rating and rating of others than did the control group on two levels. For the experimental group, no significant changes occurred from test to retest on the self-rating, but significant changes were obtained on the rating of others and discrepancy scores on three levels. The control group showed significant changes on two levels from test to retest on the self-ratings and ratings of others. There were no significant differences on the discrepancy scores. Significant changes on ratings of others and discrepancy scores occurred on the body, extra-familial and societal image levels in the experimental group. The control group showed significant changes on the extra-familial and societal images on the self and others ratings.

The findings justify the following conclusions: (1) in general, self-percepts as measured show stability over a short period, (2) control and experimental groups show differences in self-perceptual organization, (3) the several levels of self-percepts were not equally susceptible to change under experimental conditions oriented toward producing change in the personality, (4) the experimental group showed more significant changes in personality organization than did the control group, and (5) it cannot be said conclusively that the levels of self-percept respond to change on the basis of a strictly temporal order. The experimental group did not follow the postulated sequence and it was suggested that the neurotic needs of these subjects constitute one factor that may influence the ease with which certain levels may be changed. 109 pages. $2.00.

THE RELATIONSHIP BETWEEN PERSONALITY RIGIDITY AND ACCEPTANCE OF PHYSICAL DISABILITY: PERCEPTUAL AND ATTITUDINAL CORRELATES OF ADJUSTMENT TO PHYSICAL DISABILITY

(L. C. Card No. Mic 58-636)

Henry Lowenheim, Ph.D.
New York University, 1957

This investigation was concerned with the relationship between personality rigidity and acceptance of a physical disability. The subjects were English speaking adult males, twenty one to forty five years of age. Each subject had a neuromuscular disability which was incurred in adulthood at least three months prior to being included within the study. The subjects were of average or above average intelligence as measured by the Wechsler-Bellevue Scale. No subject was of the psychiatric category of psychosis or organic brain damage, nor at any time since the disability did any subject undergo psychotherapy. The subjects were in-patients of the New York University - Bellevue physical rehabilitation institute. Their disabilities were either of traumatic origin or were sustained through disease and were of a quadraplegic or paraplegic nature.

The study population was divided into two groups of twenty subjects significantly differentiated with regard to personality rigidity. The Authoritarian Scale and a Rorschach Rigidity Scale were utilized to obtain measures of personality rigidity. The two groups were equated for medical diagnosis, severity and duration of disability.

It was hypothesized that:

The neuromuscularly disabled adult male's acceptance of his disability is related to the degree of his personality rigidity.

It was further hypothesized that:

The more rigid the individual's personality the less accepting will he be of his physical disability.

Measures of acceptance of disability were obtained from judges who rated the protocols of each subject's interview. The interview was of the structured - open ended variety, geared to reflect the subject's attitudes toward his disability and himself, as well as to reflect his interpersonal relationships as they are influenced by his disability.

The high and low personality rigidity groups' ranks of acceptance of disability were put to statistical tests to determine the level of significance existing between the two groups in their acceptance of disability. The standard error of the difference between the means of the high and low groups was 2.95 and it yielded a critical ratio of 4.8 which is significant as the .0006 level.

Two chi - squares were computed from the data. The first chi - square encompassing the entire study population was 10.0 and the second chi - square encompassing seventy-five per cent of the population was 13.48. Both chi - squares were significant beyond the one per cent level of confidence. The hypotheses were effective in identifying the nature of seventy-five per cent of the subjects with regard to their acceptance of disability in the first chi - square computation and the hypotheses predicted correctly in eighty-three per cent of the subjects in the second chi - square computation.

The rank - difference correlation method was applied to the subjects' personality rigidity ranks and acceptance of disability ranks to obtain the relationship between degree of personality rigidity and the degree of acceptance of disability. A correlation coefficient of .73 with a standard error of .17 was obtained. A critical ratio of 4.29 indicated that the correlation coefficient was significant at the .006 level of confidence. The results of the study bear out the hypotheses formulated.

The results of this investigation are consistent with the theoretical formulations and the experimental findings which state that the disabled person's degree of personality rigidity determines the ultimate nature of his adjustment to a physical disability. As the relationship between personality rigidity and acceptance of disability was demonstrated beyond the one per cent level of confidence the

results of this study affirm the need for inclusion of re-educative and psychotherapeutic procedures within the rehabilitation process of the physically disabled person. It was suggested that psychological studies deal more with the physically disabled who are situated within the community to provide a broader scope of the process of adjustment to a physical disability. 126 pages. $2.00.

THE EFFICIENCY OF THREE RIGIDITY TESTS IN PREDICTING GROUP BEHAVIOR

(Publication No. 25,455)

Joseph Melvin Masling, Ph.D.
The Ohio State University, 1952

The research presented in the dissertation is the first attempt to test the usefulness of the concept of rigidity on non-laboratory behavior. Despite the wealth of information yielded by other rigidity investigations, no new light has been shed on many important considerations which face the clinician. While the present study is not regarded as definitive, it was thought important that a start be made to extend the research on rigidity to include real life behavior.

The tests used in this study are adaptations of those used by Rokeach.[1] The Map and Mathematics tests both Einstellung tests, in general test the ability of the subject to profit from changing cues in the environment. The Picture test is a measure of concept formation; the test score is theoretically a measure of the breadth of the subject's cognitive pathways.

The Map test consists of a series of ten maps. The subjects are instructed to trace the shortest path from a house, situated on the southwest corner of the map, to the candy store, situated on the northeast corner of the map. All the maps are identical except that a diagonal on the last five maps (called the "critical" problems) runs in a southwest to northeast direction; in the first five maps (called the "control" problems) this diagonal runs in a southeast to northwest direction. The score received on this test is the number of critical problems which the subject solves without use of the diagonal.

The Mathematics test consists of 12 problems, two explanatory, five controls, and five critical problems, given in that order. The following is an example of the first explanatory problem and the five controls:

> "Suppose a boy had to go to the river to bring back six quarts of water. He only has an eight quart jar and a two quart jar. What is the easiest way he can bring back six quarts?"

The secondary introductory problem and the five criticals are similar to this:

> "Suppose a boy had to go to the river to bring back three quarts of water. He only has a six quart jar and a three quart jar. What is the easiest way for him to bring back three quarts?"

The score received on this test is the number of critical problems which the subject solves by using both jars.

The Picture test consists of eight pictures taken from the book, White Collar Zoo.[2] Pictures of four birds (an owl, a pigeon, an eider, and an egret) and four four-legged animals (a bull, a bear, a dog, and a lion) were mounted on cardboard and covered with scotch tape. The subjects are asked to group, in any meaningful way, all pictures which seem to have something in common. Those animals which are seen as having nothing in common with any of the others are put in piles of one. The score received is the number of groupings made, minus one. Thus if a subject would group all the pictures together he would receive a score of zero. If all the pictures are put into piles of one, the score is seven.

The subjects in this experiment were boys in the age range of 11 to 15 years and were in attendance at either the Fresh Air Camp of the University of Michigan or the camp of the central Wisconsin YMCA, Camp Manitowish. The campers at the Fresh Air Camp were all referred by a recognized case work agency. They were all highly disturbed emotionally with most of the categories of behavior disturbances represented. For the most part the boys were of a highly aggressive, acting-out nature.

The subjects at Camp Manitowish were all without marked personality disorders. They either came from managerial-professional or middle class homes, they were at their proper age-grade placement or slightly advanced scholastically (in marked contrast to the FAC boys), and they appeared to be a normal, healthy population. The two groups of subjects represented as wide a range of differences in background and behavior as could be secured. The two camps differed even in orientation; the FAC serves as a group therapy adjunct to the individual treatment the boys receive during the winter, while the YMCA camp is frankly recreational in character.

The data were gathered in the summer of 1950 while the investigator was on the staff of the United States Public Health Service Research Project, "Use of the Group Medium for Clinically Disturbed Children." Mobile observers used pre-categorized data sheets to record the behavior of the children along selected dimensions of contagion and influence attempts. A battery of sociometric questions were asked the subjects during the first week of camp and again during their last week of camp. The rigidity tests were administered during the first week of camp, and the vocabulary section of the Stanford-Binet, Form L was given during the last week of camp. Twenty-four subjects attended the first four week session of the FAC, 32 were in attendance during the second session, and 35 subjects were taken from the second session of Camp Manitowish, making a total of 91 subjects who were used for the experiment.

Various controls and checks were instituted to insure that systematic error did not creep into the data. Each of the three observers on the field teams spent approximately the same amount of time with each of the experimental cabins. Efforts were made to insure that each of the subjects had a sufficient number of minutes spent under observation. The observers maintained a neutral role with the children. They were neither warm nor hostile, aided nor punished; it was their opinion that the children soon learned to accept them as part of the camp scenery and took their presence for granted.

The hypotheses stem from the psychoanalytic notion that rigidity is one way in which anxiety is controlled. Using this observation as a base, the author developed a small-scale theory about the relationships between rigid behavior and contagion-influence behavior and made the following hypotheses.

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1. The more rigid a child is, the less he will be imitated by other children.
2. The more rigid a child is the more he will imitate other children.
3. The more rigid a child is the fewer attempts he will make to influence directly other children.
4. The more rigid a child is the more frequently other children will attempt to influence him.
5. The more rigid a child is the more other children will see him as conforming with adult standards.
6. The more rigid a child is the more halo effect he will show on the distribution of sociometric votes on:
   a. rankings of self on the various sociometric questions
   b. rankings of others on the various sociometric questions
   c. changes in the rankings of others on repeated sociometric testing
   d. changes in the rankings of self on repeated sociometric testing.
7. The more rigid a child is the fewer changes in activity he will make.

The results of the experiment fall into two groups: those relating to the stability of the criteria and those relating to the hypotheses. The reliability of observing contagion and influence behavior is quite good, especially when the difficulties inherent in field studies are considered. Test re-test reliability (computed on a sample of 34 Columbus grade school children roughly similar to the FAC subjects) of the three rigidity tests is high enough to permit the use of the tests in an experiment such as this. Reliability of the Picture test is .92, of the Mathematics test, .89, and of the Map test, .66; combined scores of the three tests have a test re-test reliability of .77. A table of intercorrelations among the rigidity tests shows that the three tests measure distinct abilities--the intercorrelations among them are positive but low.

The differences in test scores between the two camp groups show that the FAC subjects tended to do better than the YMCA subjects on the Mathematics test, while the reverse situation is true in the case of the Map test. This finding leads to the conclusion that concrete behavior is efficient on some problems, inefficient on others. Much work on rigidity has previously indicated that all concrete behavior is inefficient. This finding is only tentative and warrants specific research directed to the problem.

The relationship between rigidity and intelligence is not statistically significant. Intelligence is definitely not related to whatever these tests measure.

The results relating to the hypotheses indicate that eight of the ten hypotheses can be rejected. These hypotheses are numbers 1,2,3,6a,6b,6c,6d, and 7. Hypothesis 4, concerning rigidity and the receiving of attempts at direct influence seems to hold up for the YMCA subjects, and to a lesser degree, for the FAC subjects. When all subjects are combined the relationship is statistically significant. Only one test of the three, the Map test, is sensitive to the relationship between rigidity and conformance with adult standards (hypothesis 5). The results clearly show that the more rigid children are seen by their peers as being more compliant with adult standards than non-rigid children.

The statistic used in testing the hypotheses was in all cases the Chi-square. Both variables were dichotomized into two equal groups. Separate Chi-squares were computed for each of the tests and for the combined test scores, although only the combined test score was reported in some cases in the larger report of the study.

A series of variations were computed after the data had been analyzed to see whether any refinements in technique would produce more satisfactory results. No amount of post-hoc variations appreciably changed the results.

This study clearly shows the inefficiency of using rigidity tests to predict group behavior. Since the methodology seems sound enough and the hypotheses are logical extensions of current theory, the lack of positive results must lie in the conceptualizing of rigidity.

Rigidity was used in this study to classify people, rather than to describe certain behavior. The notion was that some children are rigid, meaning that they behave in a certain characteristic manner in all situations. It might have been wiser to assume that there is a certain rigidity to behavior under certain circumstances, and that this varies from person to person and situation to situation. The search for the rigid character or the oral character or the authoritarian character seems intriguing, but as this study shows, using a concept in a static manner lessens the likelihood of prediction.

116 pages. $2.00. Mic 58-4844

1. Rokeach, M. "Generalized Mental Rigidity as a Factor in Ethnocentrism," J. abnorm. soc. Psychol., 43 (1948), pp. 259-278.

2. Barnes, C., Jr. White Collar Zoo. New York: Doubleday, 1949.

Abstract published by special arrangement with The Ohio State University.

RECALL OF POSITIVELY AND NEGATIVELY AFFECTIVE MATERIAL RELATED TO SELF-ESTEEM

(L. C. Card No. Mic 58-1346)

Charles T. McElvaney, Ph.D.
Columbia University, 1957

Chairman: Paul E. Eiserer

Selective recall for self-enhancing, threatening, and neutral self-relevant material related to self-esteem was investigated. Self-relevancy was introduced after learning, using a variation of Wallen's[1] method.

Better recall for desirable than for undesirable or neutral self-relevant words was predicted on a delayed recall test on the basis of reinforcement learning theory.

Better recall of undesirable than of neutral words was predicted on a delayed recall test on the basis that normal subjects would use mechanisms other than repression in an anxiety-arousing situation that would not be so traumatic as to be disorganizing and where there would be opportunities of using more integrative adjustive behavior. It was reasoned that adjustments other than repression would facilitate recall.

It was predicted that after self-relevancy was withdrawn selective recall would no longer occur on a delayed recall test.

In preliminary procedures, 39 experimental and 32 control subjects (undergraduate college students) rated themselves as having or not having each of 289 traits. They also rated each trait-word as desirable, undesirable, or neutral. Each subject also rated 3 to 5 others in the class with the trait-words.

Subjects learned 3 sets of 8 trait-words paired with three-letter nonsense syllables. Each list was composed of desirable, undesirable, or neutral words according to each subject's previous judgments. All trait-words were in disagreement with the subject's previous rating of himself. After relearning, words were made self-relevant for the experimental group by telling subjects that the words each had learned were traits others had attributed to him. A week later self-relevancy was withdrawn by telling subjects that the trait-words had not been attributed to them.

Recall tests were administered after learning, immediately and a week after self-relevancy was introduced, and immediately and a week after self-relevancy was withdrawn.

The control group replicated the experimental procedure except that self-relevancy was not introduced or withdrawn.

Analysis of the data from the control group indicated no selective recall at any time. No selective recall was found for the experimental group when recall for all words was analyzed. However, there was selective recall for the relatively "underlearned" trait-words on the delayed recall test after self-relevancy was introduced. As was hypothesized, desirable and undesirable words were recalled better than neutral words. The hypothesis that desirable words would be recalled better than undesirable was not supported. Consistent results were obtained from a measure of change in individual subject's recall preferences.

The recall test a week after withdrawal of self-relevancy indicated, contrary to the hypothesis, that desirable words continued to be recalled better than neutral words. There was no longer any difference in recall between undesirable and neutral words, although there was no change in subjects' recall preferences. Interpretation of results after withdrawal of self-relevancy was complicated by an additional learning trial after withdrawal.

Results indicated that recall was affected by the introduction of self-relevancy and that selective recall was not a function of original learning. The successful withdrawal of self-relevancy was questionable and its effects on recall were not conclusive. However, it appeared that the effects of self-relevancy on recall persisted after the attempt to withdraw self-relevancy.

Discussion was concerned with problems of measurement of effects of motivational factors in relation to degree of learning and retention. Qualitative data were presented as illustrative material suggesting adjustive reactions. Evidence from subjects' statements was consistent with the reasoning that adjustive behavior other than repression was resorted to and probably facilitated recall of self-relevant undesirable trait-words. Consideration was given to conditions of the motivational situation related to adjustive responses and effects on recall.

144 pages. $2.00.

1. R. Wallen. Ego-involvement as a determinant of selective forgetting. J. abnorm. soc. Psychol., 1942, 37, 20-39.

PSYCHOLOGICAL CORRELATES OF ALCOHOL ADDICTIONS

(L. C. Card No. Mic 58-1352)

Donal Gerald Murphy, Ph.D.
Columbia University, 1957

Chairman: Laurance F. Shaffer

The purpose of the present study was to establish, in psychological terms of moderate validity, descriptions of several groups of alcoholics segregated according to life history variables.

Reference was made to reports which described addicts as "essential," implying early and severe addiction, lack of pattern, inability to use alcohol socially for a reasonable length of time, and addiction lacking identifiable precipitating factors, and as "reactive," implying later addiction in response to life situations found intolerable, some social use, and the development of periodic or continuous patterns of drinking.

Hypothesis I proposed that, using the MMPI, essentials show profiles resembling those of psychopaths, and reactives those of neurotics, profiles being judged clinically and scored by formulas. The second part of this hypothesis held that the two groups show dissimilar elevations, as specified, in mean scale scores, while Hypothesis II proposed specified difference in mean scale scores between reactives showing periodic or continuous drinking patterns. Hypothesis III concerned the relationships between global judgments of addicts' addiction categories (on the basis of Personal History Inventories) and characteristics posited as essential or reactive for each of 12 life variables described in this inventory. Hypothesis IV suggested a relationship between social class of subjects' fathers and subjects' addiction categories.

Subjects tested were 128 males aged 20 to 55, hospitalized primarily for alcoholism and not showing indications of psychosis or deterioration. Verbal intelligence ranged from the 12th to the 99.7th percentile, compared with a large sample of adult American males. The test battery used included (a) a 20-item vocabulary test of verbal intelligence, (b) a Personal History Inventory (PHI) of 48 items, and (c) the MMPI, booklet form, items 1-406, 461 and 502; administration required approximately two hours.

MMPI profiles were sorted by four judges along a seven-step continuum running from extreme psychopathy to extreme neuroticism; statistical procedures indicated equivalence of judges' results and their ratings were summed to provide the basic distribution. Judges also indicated the cut between psychopathic and neurotic profiles. Profiles were rated in addition through the use of eight scoring formulas derived from previous research. PHIs were judged by three professionals experienced in this field; pairwise correlations of agreement between judges were significant. Of 128 records, 4 were held indeterminate, 46 were judged essential and 78 reactive. Of these last, 34 were judged periodic, 35 continuous and 9 indeterminate as to pattern.

Hypothesis I, Part A, was not supported; no significant direct relationship between addiction category and MMPI nosological category was established. Hypothesis I, Part B, was partly supported: essentials developed significantly higher mean scale scores on Sc, Ma and (contrary to hypothesis) on Pt.

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Hypothesis II was in part supported: continuous addicts showed higher mean scores on scales Hs, D and Pt. Contrary to hypothesis, continuous addicts also exceeded periodics on scale Sc.

Hypothesis III: significant congruences between global PHI judgments and nine life variables were established; significant relationships were not established with three life variables--late pattern, education and therapy experience.

Hypothesis IV: no relationship could be established between subjects' fathers' social classes and subjects' addiction categories.

Discussion of these results pointed out that this study negates the theory that alcohol addiction involves a unitary personality figuration; description of addictions along two dimensions, category and pattern, was held reasonable, and suggestions were made for future research.

123 pages. $2.00.

THE RELATIVE EFFECTIVENESS OF LARGER UNITS USED IN INTERVIEW ANALYSIS

(Publication No. 25,459)

John Edward Muthard, Ph.D.
The Ohio State University, 1952

The main purpose of the dissertation is to investigate the relative effectiveness of several larger units of analysis used in typescript research for studying client and counselor behavior. This problem is regarded as one of the basic methodological questions which needs to be resolved before interview research findings can be compared and integrated. In addition, we are interested in considering the extent to which various units enable one to determine the different roles assumed by the client and counselor during their relationship and whether these roles affect their behavior. These problems seem to warrant intensive investigation.

To develop a methodology which permits comparison and integration of the many separate findings, it is necessary to study the factors which interfere with progress toward that goal. This study marks the beginning of dealing with one factor, the use of interviews from a single counseling center or orientation. It incorporates interviews from 12 client-counselor relationships in four institutions into a single study.

An effort was also made to take into consideration a second factor, the non-comparability of dimensions. This was done by selecting for use in the study dimensions which met several criteria, reliability in rating, representativeness of the dimensions now used, and frequency of use in research. However, it was the primary purpose of this investigation to contribute to answering the problem posed by a third factor, the use of non-comparable units to segment interviews for purposes of analysis.

To attack this problem, it was considered necessary to study the relative efficiency of the units since it is unlikely that procedures can be developed to transform findings obtained by using one unit into results which would have been obtained by use of another unit. Several considerations suggested that the first study deal with larger units rather than with single speeches.

To permit the widest possible generalization from the study, interviews were selected which represented different counselors, clients, and institutions. Thirty-six interviews were selected from a pool of verbatim typescripts prepared from electrically recorded interviews at four universities, Chicago, Minnesota, Missouri, and Ohio State. Wherever possible the cases selected included all the interviews in the series of contacts. When this was not feasible (because of the length of the case) three consecutive interviews were selected from the case.

From among the larger units which might be studied, it was decided that the discussion topic and fraction should be used and that a third unit, the problem area unit, which had heretofore not been used, should also be studied.

The discussion topic represents all the conversation of both client and counselor about the same topic or subject. The division points for this unit were determined by the pooled judgments of three independent raters. After marking the divisions of the interview independently, the judges met in conference to arbitrate any differences. For a sample of nine interviews, two or all three judges agreed exactly or within the same remark for 83 per cent of the discussion topics.

A problem area unit consists of all the contiguous statements dealing with the same kind of problem. The initial step in determining their boundaries is the same as for discussion topics, but in addition it is necessary to classify each topic and place those falling in the same class together. The unit classification categories suggested by Robinson[1] were used. Test interpretation was added to the adjustment, special, and skill categories of that schema. In the sample of interviews used to examine the reliability of demarcating this unit, two or all three judges agreed within the same remark 85 per cent of the time.

As a unit, the fraction comprises a definite percentage of the total remarks within a series of counseling interviews. For the research quintiles of each series was the unit used. The reliability of determining its bounds is obviously quite high.

To compare the three units studied, the behavior within each unit had to be considered. The four concepts selected for use in the investigation were the dimensions amount of lead, counselor assumption of responsibility, client acceptance of responsibility, and working relationship. The first two are counselor and the last two client dimensions. All of these were previously used in several studies and had been found to be both reliable and sensitive measures of interview behaviors.

Persons doing the ratings for this research were advanced graduate students in the student personnel program at Ohio State University or had equivalent background and experience. The judges were trained for their specific rating tasks. The three global dimensions were rated by three judges. Only two raters were used for amount of lead, which is rated remark-by-remark, since this rating had been previously found highly reliable. Precautions were taken to avoid introducing systematic variations which might favor any of the three units being studied.

In developing procedures for examining the question posed, it was necessary to develop assumptions, testable hypotheses, statistical procedures, and some secondary hypotheses.

The assumptions made were: (a) during the course of the counseling process the behaviors of both client and

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counselor vary; (b) these behaviors can be satisfactorily rated; (c) there are factors associated with these changes, some of which are yet to be determined; (d) the unit which makes these changes more discernible will be more effective for the purpose of describing counselor and client behavior and factors associated with it than the unit which obscures them; and (e) while changes taking place during the interview series will cause differences between widely separated units, the crucial test of the differentiating value of a particular unit is its capacity to reflect changes in behavior between contiguous units in an interview series.

In the light of these assumptions, four testable hypotheses were proposed. Two of these (labeled 1a and 1b hereafter) dealt with the reliability with which the three units could be rated on the four dimensions used. In the null form they were: (1a) there is no difference between the inter-rater reliability coefficients obtained for the three different units, and (1b) the units do not differ in the degree which the first half of each unit correlates with the second half.

The two other hypotheses (labeled 2 and 3 hereafter) consider a unit's capacity for distinguishing segments of the interview, that is, they examine the extent to which the units studied make discernible variations within the interview. Hypothesis 2 was: there is no difference between the correlations obtained between ratings of two halves of a unit and those obtained between ratings of the last half of a unit and the contiguous half of the next unit. The final major hypothesis stated in the null form was: observable shifts in client and counselor behaviors from each unit to its next adjacent unit do not differ when the difference scores of the three units under study are compared.

The data used in testing the above hypotheses were the combined ratings of the several judges. For Hypotheses 1a and 3, the ratings for all four client and counselor dimensions were used. The procedures for testing Hypotheses 1b and 2 differed in that only amount of lead and working relationship ratings were used and these were for halves of the units.

To test Hypothesis 1a the ratings of each judge were correlated with each other judge who rated the same interviews. The obtained correlation coefficients were averaged --- by using the z transformation --- to secure a single reliability coefficient. The reliability coefficient for the combined ratings was then determined by applying the Spearman-Brown prophecy formula to take into account the number of raters used. The significance of the difference between each pairing of the obtained reliability coefficients was then determined.[2]

The testing of Hypothesis 1b required the correlation of ratings of the first half of each unit with those for its second half. The significance of difference between the correlations obtained for each type of unit was obtained.

The first few steps in Hypothesis 2 were similar to those for 1b. In addition, the ratings for the last half of each unit were correlated with the ratings for the first half of the next contiguous unit. The significance of the difference between the two sets of correlations, those for within-unit and those for between-unit halves, was then calculated.

The procedure for testing Hypothesis 3 was: (1) the difference scores between combined ratings of adjacent units were determined, (2) the Mann-Whitney U test[3] was used to test the hypothesis that the distributions of difference scores for the different types of units were equivalent, and (3) the U statistic was computed for the entire set of cases and its significance ascertained.

The summarized conclusions which are suggested by the data secured in this investigation are:

1. Problem area, discussion topic, and fractional (quintiles of the interview series) units were all rated with about the same degree of reliability on two counselor and two client dimensions of the counseling interview. All three units permitted ratings which were reliable enough to use in typescript research.

2. The several units do not differ in the degree that they are internally consistent. Amount of lead ratings for the two halves of each type unit inter-correlated +.75 for discussion topic units, +.79 for problem area units and +.72 for fractional units. For working relationship ratings the respective inter-correlations were: +.89, +.90 and +.86.

3. Problem area and discussion topic units differentiated segments of the interview which were behaviorally different. Fractions did not do this. For the first two units, ratings of within-unit halves correlated to a significantly greater degree than ratings of between-unit halves.

4. Use of problem area and discussion topic units makes shifts in client and counselor behavior --- as measured by ratings --- more discernible than does use of the fractional unit studied. For the four dimensions, the measures of shifts for problem area units were significantly greater than those for fractions. In the case of discussion topics this was true for three of the dimensions.

5. Problem area and discussion topic units do not differ significantly in terms of observable shifts of behavior from one unit to the next.

6. One of the bases for the variations found in discussion topic and problem area units appears to be the roles which the counseling participants accept. This statement is based upon observations made while reading more than 200 interview protocols. The analysis of roles within a "typical" interview which was made in this study also contributed to the above statement. Because of the nature of the evidence, it must be regarded as a hypothesis which merits test and not a statement of fact.

9. For the three units studied, the inter-correlations among the four dimensions used were quite similar. For each of the units, the ratings of the four dimensions were inter-related to a significant degree.

Since this is one of the first studies which uses counseling interview records from several institutions, it was believed that there would be some value in investigating whether the schools differ on the dimensions studied. It was recognized that the data secured represented a limited sampling --- three different clients in nine interviews --- from each campus, and that any findings obtained would have to be considered very tentative. Keeping this in mind, two additional questions were posed. Do the types of problems dealt with at the several counseling centers differ? Do the mean and standard deviation values for the combined ratings of the four dimensions differ among the four institutions?

In both instances, the data pertinent to the questions were tabulated. The first was tested by a chi-square analysis. Since the data obtained for the second problem suggested that the three interviews at each of the schools tended to differ one from the other, only descriptive statistical measures were obtained.

From the data secured in examining these questions the following conclusions were drawn:

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1. In making studies which are concerned with the differences in client and counselor behaviors, it appears desirable to take into consideration any differential distribution of problem types at each of the schools studied.

2. Studies which incorporate counseling records from several institutions need to take into consideration the client and counselor differences at each institution before attempting any comparisons between schools.

275 pages. $3.55. Mic 58-4845

1. Robinson, F. P. Principles and Procedures in Student Counseling. New York: Harper and Bros., 1950, pp. 168-173.

2. Lindquist, E. F. Statistical Analysis in Educational Research. Boston: Houghton Mifflin, 1940, pp. 214-218.

3. Mann, H. B. and Whitney, D. R. "On a Test of Whether One of Two Random Variables is Stochastically Larger Than the Other," Ann. Math. Statist., 18 (1947), pp. 50-60.

Abstract published by special arrangement with The Ohio State University.

CONFLICT AND DEFENSE IN THREE PSYCHOSOMATIC SYNDROMES

(L. C. Card No. Mic 58-974)

Donald Mitchell Pollie, Ph.D.
University of Michigan, 1957

The present study explored some of the psychological characteristics of hospitalized male veterans who manifested the symptoms of either of three psychosomatic syndromes. A battery of appropriate psychological tests was administered to sixty-one duodenal ulcer patients, fifty-two nonulcerated gastrointestinal patients, and forty-six bronchial asthmatics free of major gastrointestinal symptoms. This battery included a Personal Information Questionnaire for assessment of life history material and certain of the patients' opinions about the emotional aspects of their illnesses; the Blacky Pictures, a modified projective technique for measurement of psychological conflicts; and the Defense Preference Inquiry for measurement of defense preferences.

The responses of these three psychosomatic groups were contrasted with each other and were also compared with the responses of a group of twenty male hospital patients afflicted with nonpsychosomatic illnesses. This latter group represented a psychologically normal sample of hospital patients.

The following characteristics typified the ulcer patients. They attempted to conceal signs of psychological disturbance in almost all areas of psychological conflict, even though they were of great importance for their illness. They avoided expression of hostile feelings, feelings of inadequacy, and feelings of fear of punishment. They emphasized the approving and tolerant attitudes of the parents and their own masculine adequacy. They were involved in an inner struggle to control expression of attitudes and needs unacceptable to their self-imposed demands for exemplary behavior. Tension and anxiety accompanied these attempts at control.

The following characteristics typified the asthmatics. They were less defensive than the ulcer subjects. The asthmatics indicated a greater preference for avoidance and a lower preference for reaction formation as defenses. Overattachment to the mother was the focus of their psychological disturbance. She was, for them, the object of attitudes of both intense love and hate, and was regarded as the decisive disciplinarian. The asthmatics were intensely hostile toward other members of the family who threatened to come between them and the mother. In their love relationships, they preferred a mother-like love object.

Neither the nonulcerated gastrointestinal patients nor the nonpsychosomatic patients were very clearly distinguished from the others. However, the former group as well as the ulcer and asthma patients, were psychologically more disturbed than the nonpsychosomatic subjects.

In view of these results, it was concluded that specific personality features are exhibited by the individuals who manifest the symptoms of these three psychosomatic syndromes. These features are most similar to those cited by Alexander and his coworkers as etiologically significant for these illnesses.

Further theoretical considerations were explored and suggestions for future research were proposed in the light of these considerations. 197 pages. $2.60.

EFFECT OF CHILDHOOD PUNISHMENT AND REWARD UPON OBSERVABLE PERSONALITY CHARACTERISTICS OF THE ADULT

(Publication No. 25,417)

Robert Emerson Potts, Ph.D.
The Ohio State University, 1952

The attitudes of the individual, expressed through verbal communication and behavior, are termed his "personality." It is accepted in psychology today that these attitudes are not instinctual, nor due solely to physical growth and development, but are in fact the result of environmental learning. Clearly the young child spends more time with his parents than with anyone else. Since the parents control such biological functions as eating, toilet training, etc., and determine goals for the child on these functions, we can assume that the parents also determine social goals. This means that certain behaviors of the child are either approved or disapproved. Also the parent gradually becomes more important to the child because it is the parent who satisfies the biological-primitive needs and by sheer close association with the child's primitive satisfaction increases in value in the eyes of the child. Thus gradually the child comes to see pleasing the parent as a goal in itself, and thus social behavior as designated by the parent becomes important to the child.

These things permanently affect the child's personality because they come at a time when the child is impressionable. They recur often enough to make the behavior remain as part of the child's total behavior. The thesis of the paper is that the more potent of the acts that the parents disapproved or approved of will be remembered even in adulthood. It is assumed that a questionnaire can be constructed which will measure these remembered parental acts. These are then related to the ratings of the child

(now grown to adulthood) by his fraternity brothers who know him well. If it is assumed that a youth who is well adjusted to his group will be well adjusted to his own capabilities, any inner problem will be reflected in his behavior and relationships in the fraternity house.

To find out about the punishments and rewards given children, the memory of them was tested by giving adults a questionnaire with 17 kinds of punishment and 7 kinds of reward listed. The subjects checked whether mother, father, grandparent, or some other person administered punishment during each of four age periods: 2 to 6 years, 7 to 12 years, 13 to 16 years, and 17 to the present. Subjects could indicate whether punishment was administered never, less than once a year, 1 to 10 times a year, several times a month, and once weekly or more. From this it was possible to determine whom the child remembered as giving him punishment or reward during each of the age periods -- and also with what frequency it was carried out. The small chart shows the format of the markings indicating how much in one case mother and father used isolation as a kind of punishment. For subjects, a group of 30 fraternity brothers at Ohio Wesleyan University from the middle socio-economic class were chosen as representative, preliminary data having been run on four other similar groups.

Example: Isolation as a method of punishment (in own room alone, or in corner alone)

	Never	Less than once a year	1-10 times a year	Several times a month	Once weekly or more
Age 2-6	M-F				
Age 7-12		F	M		
Age 13-16			F	M	
17 and over	M-F				

The above example, as it is filled out, would mean that isolation as a method of punishment in your home was used by neither mother nor father when you were between the ages of 2-6, was not used by father between ages 7 and 12, was used 1 to 10 times a year by mother during that age period, was used by father less than once a year and by mother 1 to 10 times a year when you were between 13 and 16, and was never used by either parent after you were 17.

The purpose of the study was to compare the items given on the questionnaire of punishment and reward with the ratings given each youth on a graphic rating scale by his fraternity brothers. Nine dimensions of adjustment were used. Each fraternity brother rated a large number of other members so that reliability and validity could be established. From this I hoped to determine what conditions of reward and punishment as remembered by the subject might lead to a person being rated as either adjusted or not adjusted by his "brothers."

In comparing measures of punishment and reward with these ratings, four hypotheses that seemed useful were tested. These are stated here in sequence of the importance of these findings to the treatment of children.

Analysis of 18 Graphs

1) The total amount of punishment appears to make little difference in determining whether a youth is judged by his fraternity brothers as being adjusted or not.

2) It appears that all family groups tend to be remembered as rather lenient in the 2-6 period. All families then appear to be remembered as giving the child more punishment during the 7-12 period than at anytime before or after this period. The punishment then gradually decreases in the 13-16 period, and in the 17 "plus" period. This indicates that the total amount of punishment is a culturally induced phenomena -- people punish their children because it is "the thing to do" in our society.

3) There are significant graphic differences in the judged adjustment of youth because of certain kinds of reward. This is also discussed from a mathematical standpoint.

Total Amount of Reward

While not significant for all of the nine levels of adjustment rated, a t-test indicated significance at the 10 per cent level for the leaners vs. the non-leaners in our society. Those who leaned heavily on their families got more total reward from their families than those who became independent from the mother and father. In addition, the leaners throughout their growing-up period kept more closely to the same amount of reward given them in early childhood. The non-leaners appeared to move progressively away from parental reward as they grew up, from 7 years of age on.

Inconsistency Hypotheses

While not significant on all rated levels of adjustment, on the Social Participation and Leadership dimension it was found that the leaders had mothers and fathers who agreed on the amount of punishment given the child. The non-leaders tended to have mothers and fathers who disagreed on the amounts of punishment given the child, significance on the "t" test being at 5 per cent level.

On the dimension of Decision Making, the decision-makers were found to have mothers and fathers who agreed on amount of punishment. The indecisives had parents who could not agree on the amount of punishment to be given. In both cases the mother gave the larger amount of punishment, but the difference between parents was particularly greater for the indecisives, the significance by t-test being at 10 per cent level; for the decision-makers it was only at chance levels.

On the Competitiveness and Ambition dimension, the non-ambitious were found to have parents who agreed on amounts of punishment. On the other hand, the ambitious had parents who had differences on the amount of punishment given the child. Data further indicates that the ambitious had a mother who was more punishing than was the father. Significance by t of this inconsistency was at the 10 per cent level.

Trends not significant but of interest for further investigation are: highly suspicious subjects have more rewarding fathers than mothers; the friendly people have equally rewarding mothers and fathers; The worriers have a more punishing mother than father; The hostile had a more punishing mother than father; the independent subjects were rewarded less by their father than mother; the tolerant had a mother and father who were equally rewarding, while the intolerant had parents who differed in the amount of reward given the child; the decision-makers did not have their punishment changed once it was decided

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upon by the parents while the indecisives had theirs altered after its imposition.

Validation was next attempted by comparing means of ratings given the best adjusted group (of 15 subjects) with the means of a group of neurotics at the State Hospital in Columbus. Differences were easily observable by inspection, indicating that the rating scale was valid by this means of comparison. Also, observable differences were noted between neurotic group means and the total college group, except on the dimension of Generousness and Consideration.

Further, a factor analysis was made indicating that there were three factors measured by the nine adjustment rating scales. The first two factors are particularly significant; and based on the factor loadings we find there are several types of adjustment, for example:

A. Executive ability, ambitious, organizer, leader, takes initiative, go getter
B. Permissive, open-minded, easy-going, slow to anger, unprejudiced, accepting.

This indicates that an over-all adjustment includes more than one factor, and judgment of whether an individual is adjusted to society or not is the result of what measures of adjustment are used to determine adjustment.

The study is designed to determine meaningful variables for later investigation. The lack of studies in this area indicates that much research is needed. The lack of differentiation on objective measures of punishment, and, in contradistinction, the discriminating effect of reward measures lead me to suggest that perhaps further investigation of the problem of punishment is not too pressing inasmuch as the punishment measures were not predictive. Further, it is suggested that deeper probing of the problem of measures of reward may be productive of predictive dimensions. 196 pages. $2.55. Mic 58-4846

Abstract published by special arrangement with The Ohio State University.

SOME DETERMINANTS OF THERAPIST BEHAVIOR

(L. C. Card No. Mic 58-979)

David Rigler, Ph.D.
University of Michigan, 1957

The immediate focus of research in psychotherapy has usually been directly upon the patient. While the patient's welfare remains the ultimate research goal, the present study was derived from the thesis that the therapist's personality and his reactions represent primary elements in the interaction which takes place between therapist and patient.

The present experiment chose to examine several therapist variables for the purpose of testing two hypotheses relating them. The variables were: the level of ambiguity of the therapist's behavior; his anxiety as measured by the galvanic skin response; and the presence of conflict in the communications of the participants. The hypotheses were as follows:

1. Therapists would exhibit greater anxiety during periods when they were dealing with conflict areas than with non-conflict areas.
2. A greater degree of therapist anxiety will be associated with increased structuring on the part of the therapists.

The procedure adopted to test the hypotheses required that the personality of therapist-subjects be evaluated to determine areas of relative conflict and non-conflict. This was accomplished by noting the concordance or disparity between scores on a group of traits, made by the therapist himself and by a group of his evaluators. Each of the subjects then recorded a number of therapeutic interviews which he conducted. With the aid of typescripts, the verbal responses of the participants were coded to indicate which communications were relatively conflictful and which were conflict-free. The typescripts were also scored to show how ambiguous was the therapist's behavior. Anxiety measurements were derived from a tracing of the therapist's skin resistance made soon after the interview during a period in which the therapist listened to a playback of the recording.

Three therapist-subjects recorded a total of thirty-six interviews among eight clients seen in a university counseling agency. The first hypothesis, linking conflict with arousal of therapist anxiety, was not sustained when the conflict was manifested via the therapist's own responses; when it was the patient who emitted the conflictful behavior the hypothesis was, however, decisively supported. The discrepancy in findings under the two conditions was explained as resulting from a differential need or ability to defend against anxiety arousing conflict. With regard to hypothesis 2., the results are less clear; correlations between ambiguity and anxiety were statistically significant for only one of the three subjects and even these correlations were low. Failure to achieve a more positive result, it was felt, was associated either with a successful defense against anxiety or with possible inadequacies of measurement in the experimental methodology. It was noted that the failure to find a relationship between GSR and ambiguity paralleled the finding regarding the first hypothesis in one important sense: namely, it was difficult to establish differential GSRs during the therapist responses.

Additional findings which were discussed were the dozing reaction of one of the subjects when listening to a particular client, and the indication, on an exploratory level, of a positive correlation of GSRs between two individuals who listened to the same interview.

In addition to the support given by the findings to the validation of the countertransference concept, it was felt that the study contributed to the solution of methodological problems in psychotherapy research. As a by product, it was also felt that the emotional impact of a therapist hearing his own interviews was sufficiently great as to warrant further exploration and expansion of this procedure in the training of psychotherapists. 149 pages. $2.00.

PAIRED-ASSOCIATE LEARNING BY SCHIZOPHRENIC SUBJECTS UNDER CONDITIONS OF PERSONAL AND IMPERSONAL REWARD AND PUNISHMENT

(L. C. Card No. Mic 58-1304)

Nancy Lou Mayer Robinson, Ph.D.
Stanford University, 1958

This study stemmed from a theory of the etiology of schizophrenia, which concerns essentially the difference between the strong and efficient techniques the pre-schizophrenic child develops for dealing with punishment and rejection by his parents, and the inefficient and confused techniques he develops for dealing with their ambivalent and untrustworthy praise. It was predicted (1) that, in a situation in which the only means of avoiding punishment (other than complete withdrawal from the situation) is to make the correct response, learning by schizophrenics will be facilitated and they will learn more rapidly in this situation than under conditions of reward for correct responses, or of no reinforcement, and (2) that inclusion of an interpersonal element in reward or punishment will lead to a strengthening of the effect of either reinforcement on the behavior of schizophrenics.

Five groups of male, hospitalized, schizophrenic veterans were required to learn three lists of paired-associate adjectives from a memory drum. No group received any reinforcement during the first list. During the second and third lists, the no-reinforcement group received no reinforcement, the personal reward group received mild praise from the experimenter following correct responses, the personal punishment group received mild reproof from the experimenter following incorrect responses, the impersonal reward group heard the sound of an adding machine following correct responses, and the impersonal punishment group heard an identical sound following incorrect responses. A questionnaire concerning the subject's awareness of the reinforcement and his attitude toward it was administered following the third list.

The results of the study led to these major conclusions:

(1) In this situation, punishment motivates more effective learning by schizophrenics than does reward,

(2) Reward, in this situation, does not serve as a positive reinforcer for schizophrenic patients, and it may indeed lead to a decrement in the performance of the responses it follows.

(3) Impersonal and personal reinforcement procedures may or may not lead to differential effects with schizophrenic subjects in terms of their performance on a complex learning task. It is possible

(a) that the two kinds of reinforcement were actually not essentially different,
(b) that the two different kinds of reinforcement do not lead to differential effects, or
(c) that because of generalization phenomena, in this situation learned responses to punishment generalize to other cues but that learned responses to reward do not, the two responses differing markedly in strength.

Implications of the study were discussed in terms of an etiological theory of the nature of schizophrenia, and suggestions for future research were outlined.

83 pages. $2.00.

A STUDY OF SELECTIVE MEMORY CHANGES AFTER ELECTROSHOCK TREATMENTS

(L. C. Card No. Mic 58-640)

Bernard Roth, Ph.D.
New York University, 1957

This investigation had a two-fold purpose. The first objective was to determine whether a series of electroshock treatments discriminatively affect the memories of severely depressed patients, resulting in a selective forgetting of specific pre-treatment emotional and/or non-emotional responses to psychological test material. The second facet of the study was to ascertain whether the ability of depressed patients to remember or forget their pre-treatment emotional or non-emotional responses was related to post-electroshock clinical improvement. The hypotheses were (1) that depressed patients will forget more of their pre-treatment emotional responses than non-emotional responses after a course of electroshock treatments, and that such a difference will not occur with non-treated patients or normal subjects; and (2) that following the receipt of a series of electroshock treatments, clinical improvement will be positively correlated with the patient's ability to forget pre-treatment emotionally charged responses to projective test items.

The total experimental population consisted of 40 pathologically depressed patients and 20 normal subjects. Of the 40 depressed patients, 20 were symptomatologically diagnosed schizophrenia with depression, and the remaining 20 patients diagnosed involutional melancholia. While, of each clinical group of 20 patients, 10 received electroshock treatments and 10 did not, all patients were designated electroshock candidates. To control for the possible intrusion of secondary sources of variation, only male subjects within specified age ranges were accepted for the study. Accepted schizophrenic patients were between 20 and 40 years old, while accepted involutional patients were between 45 and 60 years old. Of the 20 normal subjects, 10 were between the ages of 20 and 40 years, and the remaining 10 between the ages of 40 and 60 years. The means of the ages of the three sub-groups within each age range did not differ significantly from one another.

The projective tests used in the investigation consisted of the Orbison Word Association list and the Harrower Multiple Choice Test for use with Rorschach cards. Methodologically, the testing procedures involved a test of the ability of the patients to recognize and/or recall earlier responses to the above tests. Analyses of variance for the differences between the means of the six subgroups were made in order to ascertain whether electroshock treatments, illness, or time were the significant factors in determining selective recall and/or recognition of emotional and/or non-emotional material. Secondly, comparisons of the percentages of recall and recognition of non-emotional and emotional responses were made in order to determine whether more non-emotional than emotional material was forgotten. Lastly, correlations were computed between recall and recognition of emotional and non-emotional material and clinical improvement of both electroshock treated and non-treated patients.

The investigation yielded the following results: (1) All groups, electroshock treated patients, non-treated patients,

and normal subjects, demonstrated a statistically significant greater recall and recognition of non-emotional than emotional responses; (2) the means of the six sub-groups for the recall of emotional and non-emotional responses did not differ significantly from each other; (3) the means of the six sub-groups did differ significantly from one another with reference to the recognition of both emotional and non-emotional responses; and (4) recall and recognition of both emotional and non-emotional responses appear to be inconsistently correlated with clinical improvement.

134 pages. $2.00.

METHODOLOGICAL STUDY OF VASOMOTOR CONDITIONING IN HUMAN SUBJECTS

(L. C. Card No. Mic 58-1094)

Barour M. Shmavonian, Ph.D.
University of Washington, 1957

The purpose of this experiment was: (1) to determine if vasomotor conditioning could clearly be established in the laboratory; (2) to determine whether HR and RR were related to such conditioning; and (3) to determine if possible the reasons why Harwood did not obtain such conditioning.

Thirty-one human male subjects were employed in the experiment. These subjects were divided into three groups.

Group I consisted of thirteen subjects. The CS was a tone of 512 cycles adjusted to 15 db above threshold. The US was a mild electric shock. The subjects received ten paired presentations of CS preceding the US by ten seconds and overlapping for another five seconds. After the ten paired stimulations, ten CSs were presented alone. All of the subjects showed conditioning and the subject by trial amplitude averages yielded typical acquisition and extinction curves. HR and RR did not show any related conditioning and this was explained in terms of the possibility of inadequate recording techniques.

Group II consisted of 12 subjects and was divided into two sub groups. Both sub groups received identical treatment as group I with one exception: group IIa subjects had their recording hands in a cold chamber two-to-four degrees C. Group IIa showed slightly erratic acquisition and extinction curves. Group IIb showed extremely small vascular activity and no conditioning. This latter group was similar to Harwood's experimental subjects whose recording hands were in a cold chamber two-to-seven degrees C. as a necessary measure for adequate use of a thermistor.

Group III consisted of six subjects. The procedure was identical to that of group I with the exception that the CS was a 60 watt blue light instead of tone. One subject had erratic vascular activity and did not react to the US. Another subject showed small responses to the US and no conditioning. The remaining four showed conditioning and extinction much in the manner of group I.

48 pages. $2.00.

A FACTOR ANALYSIS OF SELECTED PERSONALITY DOMAINS

(L. C. Card No. Mic 58-1462)

Leon Michael Sirota, Ph.D.
University of Michigan, 1957

This investigation was conducted to test the general theoretical assumption that there is a coherent structure underlying personality which manifests itself in widely different behaviors. The purpose of the study, therefore, was to test and interpret the interrelationships among a large number of psychological measures selected to represent behaviors emphasized as central by current theories of personality.

From a series of previous researches, scores on 136 variables were available for 44 male college subjects. A master matrix of intercorrelations was prepared; examination of this matrix showed that 75 of the 136 variables were significantly interrelated.

These 75 variables were distributed among the following domains: psychosexual conflict (the Blacky Pictures --9 variables), ego defense preference (the Defense Preference Inquiry--18 variables), vocational interests (the Strong Vocational Interest Blank and major academic field--13 variables), values (the Allport-Vernon-Lindzey Study of Values--4 variables), perception of the attributes of the social group (4 variables), physical symptoms (6 variables), humor preference and recall (10 variables), interpersonal mechanisms of interaction (7 variables), and perceptual accuracy (1 variable).

Eight centroid factors extracted from the correlation matrix appeared to account for sufficient variance to be considered as real factors. These eight factors were then rotated by the quartimax method and the resultant orthogonal factor matrix was shown to meet in essence Thurstone's criteria for simple structure. All domains included in the study were represented in at least two common factors and all eight factors were defined by variables from at least 4 and typically 7 domains.

The eight rotated factors were tentatively named and interpreted as follows:

Factor I Exploitativeness--a business orientation toward life. The aggressive, "realistic", self-maintaining qualities connoted by the term "go-getter". The utilization of the material resources of the world, perhaps as a defense against the repetition of early oral frustration.

Factor II Expression of Hostility vs. Hostile Withdrawal --the first of several factors in this study related to a continuum of expression-avoidance of impulses.

Factor III Competition vs. Altruism--the competitiveness is of the sibling rivalry type. The altruism seems to be a defensive compensation against the guilt that is aroused by rivalrous feelings.

Factor IV Relationship Defining--a sensitivity to what others are doing and thinking stemming from a desire to clarify relationships. This sensitivity may result in variability of mode of interpersonal interaction. This factor may reflect in part the neuroticism factor found in other studies.

Factor V Punishing--projection of guilt into the world resulting in a punitive attitude toward others.

Factor VI Perception of Hostility in Others--the degree of sensitivity to hostility in others, perhaps as a function of defensive reactions to oedipal and castration problems.

Factor VII Impulse Expression vs. Impulse Control--a general dimension of expressive-avoidant defensive modes regardless of specific content of impulses. This factor is perhaps related to the introversive-extraversive factor isolated in other studies.

Factor VIII Paternalism--dealing with the need for support from others by becoming the supportive one.

While the nature of these factors in some degree depends upon the nature of the sample of variables, the existence of a clear-cut simple factor structure in the data gives strong support to the view that behavior identified as belonging to widely varying domains may be logically regarded as manifestations of fewer and more inclusive underlying dimensions. 134 pages. $2.00.

THE RELATIONSHIP BETWEEN DEPTH OF INTERPRETATION AND VERBAL EXPRESSIONS OF RESISTANCE IN PSYCHOTHERAPY

(L. C. Card No. Mic 58-997)

Joseph Chester Speisman, Ph.D.
University of Michigan, 1957

The specific problem for the investigation was the effect which the depth of a given therapist interpretation may have on the resistance of the following patient statement. This was set forth in the form of a general proposition: Deep Interpretations lead to highest resistance, Moderate Interpretations lead to the lowest resistance, and the magnitude of resistance following Superficial Interpretations will fall somewhere between the other two levels.

Depth of interpretation was defined as the disparity between the therapist's view of the patient's emotions and motivations, and the patient's own awareness of these emotions and motivations. A seven point rating scale which had been previously developed for use with this definition, was utilized for the measurement of the depth of the therapist's interpretations.

The aspects of resistance with which this study was concerned were defined by six categories descriptive of the patient's modes of verbal communication. These categories were as follows:

Exploration: The degree to which the patient expresses his thoughts or feelings.

Superficiality: The degree to which the patient's comment is superficial as opposed to meaningful.

Self Orientation: The degree to which the patient indicates his own involvement in the problem.

Self Scrutiny: The degree to which the patient is reacting to his own verbalizations.

Opposition: The degree to which the patient is oppositional toward the therapist or the therapeutic process.

Blocking: The degree to which the patient is avoiding expression of a thought or feeling.

Each category of resistance was accompanied by a seven-point rating scale on which the end points were defined.

Data for the study were derived from two sources. The first source was all responses from a sequence of five interviews from the same case. The second source was composed of units of eleven responses drawn from each of twenty-one different cases. Three judges independently rated the therapist responses using the Depth of Interpretation scale. Three different judges independently rated the patient responses using the six rating scales for resistance. The therapist responses were deleted from the interviews for the resistance ratings. This was done to avoid the ratings' being influenced by the judges' expectations as to the effects of therapist comments on the patient responses.

Since the resistance measures were developed as part of this investigation, they were evaluated as part of the analyses. The reliabilities of five of the resistance scales, i.e., Exploration, Opposition, Self Scrutiny, Superficiality, and Self Orientation, were found to be adequate. The sixth scale, Blocking, could not be rated reliably and was discarded. An evaluation of the construct validity of the remaining five scales indicated that all except Self Orientation were sufficiently valid measures of resistance. When the remaining scales were intercorrelated, however, it was found that only Opposition was independent of the other measures. Although all the remaining scales produced positive results, the Exploration measure was found to be the most efficient. Consequently, the Opposition and Exploration scales are suggested as the measures for resistance which might best be retained for future studies.

All four hypotheses which were derived to test the relationships between depth of interpretation and resistance, as proposed above, were supported by the results obtained. Two of the hypotheses were concerned with the absolute amounts of resistance which followed the different levels of interpretation, and although significant results were obtained in the predicted directions, the amount of the variance accounted for was small. The other two hypotheses compared the effects on resistance of changes from one level of interpretation to another. In this case not only were highly significant results obtained, but they consistently accounted for a large part of the variation of resistance.

Two general conclusions were drawn from the study. (1) Two aspects of resistance can be defined and put in measurable form; (2) if a therapist desires to maintain resistance at a minimum level, then Moderate Interpretations appear to be the most useful technique.

105 pages. $2.00.

AN APPRAISAL OF FREUD'S CONCEPT OF THE SUPEREGO AND AN ANALYSIS OF ITS RELATIONSHIP TO ETHICAL VALUE-SYSTEMS

(L. C. Card No. Mic 58-618)

Ellis Mills Sprague, Ph.D.
Cornell University, 1957

The purpose of this study was to undertake an appraisal of Freud's concept of the superego and to determine its significance for ethics. It has been assumed that this problem is in part psychological and in part philosophical

in character. The evaluation of the concept of the superego primarily consists in determining the degree to which available evidence either confirms or discredits the concept.

However, the validity of the concept of the superego is partly dependent upon the scientific status of psychoanalysis in general. This question is one which falls in the field of the philosophy of science, for it involves the nature of scientific knowledge. The question of whether or not moral standards maintained by the superego can be judged in regard to their ethical validity is also of a philosophical nature.

The psychological part of this thesis has consisted in a preliminary examination of several of the basic concepts of psychoanalysis in preparation for the systematic exposition of Freud's concept of the superego. Appraisal of this concept has then been carried out by means of a logical analysis of its consistency with other concepts of psychoanalysis and in terms of empirical evidence secured from clinical, experimental, and anthropological sources.

In order to determine the ethical implications of the concept of the superego, both logical and "presuppositional" analysis have been used. That is, the most general assumptions or presuppositions of psychoanalysis have been disclosed and an analysis has been made of the degree to which concepts derived from them can be developed without breaking down in contradictions. It has been assumed that this provides an indirect means of testing the validity of these presuppositions.

In an attempt to clarify the problem of finding an adequate basis for the making of ethical judgments, several ethical systems have been examined and compared with that of psychoanalysis. The positions investigated were John Dewey's pragmatism, Mortimer Adler's neo-scholasticism, and George Berkeley's idealism.

As a result of this research the following conclusions were reached. It was found that, on the whole, the validity of the concept of the superego has been confirmed by available data. However, it was noted that there are mythical elements in psychoanalysis which jeopardize its scientific standing. Among these myths are those of the death instinct, the primal parricide, and the existence of a universal Oedipus complex.

The conclusion was reached that the basic assumptions of psychoanalysis cannot be considered to be scientific, at least in terms of the criteria of experimental science. However, it was suggested that psychoanalysis may be considered to be a descriptive science provided two conditions are met. First, it should conform to a systematic pattern of inquiry in solving its problems, such as that outlined by Dewey, in order to isolate variable factors which influence interpretations that are made. The second condition is that generalizations should not be made which are not strictly warranted by psychoanalytical data.

With reference to ethics, it was concluded that psychoanalysis could not be used as a basis for making ethical judgments. Evidence was cited to show that this was Freud's own view. Contrary to Freud, however, it was found that psychoanalysis could not be used to discredit the possibility of developing a scientific ethics. It was also found that there are substantial objections to developing ethical concepts on the foundation of pragmatism, neo-scholasticism, or Berkeley's idealism.

The positive conclusion reached in this study was that the Socratic method provides a promising means of disclosing ethical concepts. It has the advantage of avoiding arbitrariness in the development of ethical principles and it effectively relates ethical concepts to everyday living.

492 pages. $6.25.

THE EDUCATIONAL BACKGROUND OF MALE SCHIZOPHRENIC PATIENTS

(L. C. Card No. Mic 58-1146)

Robert Gerard Warnken, Ph.D.
University of Minnesota, 1957

Adviser: Ralph F. Berdie, Ph.D.

The early age of hospital admission of schizophrenics suggests that educational history is a pertinent source of information for research into the etiology and process of schizophrenia, and for early identification, treatment and rehabilitation.

In this study cumulative record cards maintained by the Minneapolis Public Schools were studied for differences between a group of 116 male veteran schizophrenics and a random sample matched for age.

Major results and conclusions are as follows:

1) Fathers of schizophrenics were significantly more often employed in the lower occupational levels, and were more often unemployed. More parents of schizophrenics were foreign-born; more mothers of schizophrenics were employed. Significant differences were not found in family size, sibling position, and broken homes.

2) Schizophrenics scored significantly lower on intelligence tests at all school levels, from primary grades through graduation from high school. They obtained significantly lower school marks in academic subjects at the primary, intermediate, and junior high school levels. Significant differences in school marks were not found in senior high school. Correlations between intelligence test scores and academic grade averages for schizophrenics were higher at all school levels, but not significantly so, suggesting the hypothesis of greater academic predictability. When matched for American Council on Education scores, high school from which graduated, and date graduated, another sample of schizophrenics scored significantly higher in high school rank than did appropriate matched controls. This finding was related to different motivations for pre-schizophrenic subjects.

3) A significantly greater number of schizophrenics dropped out of school, were retarded, had physical handicaps, poorer general health, were in special classes, were diagnosed as having nervous disorders, and were absent from school more often. They were referred more often to school specialists, had a greater variety of problems, and had more severe problems.

4) The evidence did not support the hypothesis of restriction of claimed interests. Behavior rather than interests seemed to be crucial. Significantly fewer schizophrenics participated in extracurricular activities of all kinds except glee club. High school graduates

among controls worked outside of school in significantly greater numbers than drop outs. No difference was found in work experience between graduates and drop outs among schizophrenics. Occupational level was not found related to work experience in either group. Control subjects made vocational choices in significantly greater numbers, made more realistic vocational choices, and made less frequent change of choice than did schizophrenics.

5) At all four school levels a significantly larger number of schizophrenics were rated as passive by their teachers on a five point scale ranging from most passive to most aggressive. Adjectives and phrases used by teachers in describing students were reduced to 115 representative words, 43 of which significantly differentiated between controls and experimentals at one or more stages of schooling. Adjectives which were significantly more often used to describe schizophrenics conformed to the clinical picture of the schizoid personality. Adjectives which were significantly more frequently used to describe control subjects represented traits not commonly found in the schizoid personality.

6) The writer gave examples of predictive indices, using number of differentiating variables and combinations of differentiating variables, for use at various school levels. He concludes from the evidence of the study that the clue to the schizophrenic process lies in the inferior social and intellectual equipment of the average schizophrenic for the natural, though not inevitable, concomitant to inferiority is repeated failure. The process which begins in repeated failure results in a learned withdrawal from interpersonal relationships and ends in abrogating the need for others.

319 pages. $4.10.

PSYCHOLOGY, EXPERIMENTAL

EFFECT OF ACHIEVEMENT-AFFILIATION MOTIVE PATTERNS ON YIELDING BEHAVIOR IN TWO-PERSON GROUPS

(L. C. Card No. Mic 58-897)

Robert Harvey Davage, Ph.D.
University of Michigan, 1957

Chairman: W. J. McKeachie

This investigation attempted to determine which of two subjects who differed in the pattern of their achievement-affiliation motivation would yield to the other's opposing viewpoint.

Subjects were 78 college students, selected on scores of a projective measure of achievement and affiliation motivation. All subjects had high achievement scores, half of them having high affiliation scores, half having low affiliation scores. Prior to the experiment, high achievers-high in affiliation and high achievers-low in affiliation, who were to be paired with each other in two-person groups, were matched for (1) aptitude, (2) past experience related to the experimental task, and (3) improbability of previous contact with each other.

In the experiment, each subject, individually, ranked photographs for artistic merit and wrote explanations for his choice of ranking. Photographs had been chosen and grouped in a way that would maximize differences in rankings. Achievement motivation was aroused by instructing the subject to make the best judgments he could. When finished, each subject was told that his overall judgments had been excellent.

Then, subjects who had been matched prior to the experiment were placed in two-person groups and required to discuss and rank one of the same sets of photographs that each had judged individually. Although their individual judgments differed, paired subjects had to agree on a single group judgment. Thus, the group task demanded from the subjects some degree of yielding behavior. In this situation, both achievement and affiliation motivation were aroused by having subjects (1) aim for the best possible set of judgments, and (2) make sociometric evaluations of each other. Generally, strong achievement motivation was expected to direct the subject to remain steadfast in his earlier "excellent" judgments. Strong affiliation motivation was expected to direct the subject toward yielding his earlier-achieved judgments in order to gain an affiliative response.

The measure of yielding behavior was based on the correlation between the subject's individual rankings and his group-modified rankings of the same photographs. Measures of each subject's reactions to himself, his partner, and to the experimental situation were obtained from (1) his written responses to questionnaires and (2) interactional analyses based on the experimenter's observation of subjects' overt behaviors.

Results showed that the high achiever-high in affiliation was significantly less often the yielding member of the pair. Statistically significant findings accounting for his lesser yielding revealed that the high achiever-high in affiliation, when compared with the high achiever-low in affiliation, more often (1) watched his partner carefully for signs of reactions, (2) asked for his partner's opinion before stating his own, (3) complimented his partner, and (4) dominated the conversation.

Results further showed that greater divergence between individual judgments of paired subjects produced a greater stress in the high achiever-high in affiliation than in his partner. Under these conditions, he was significantly less (1) skillful in social relations, and (2) dominant in the conversation.

Thus, instead of sacrificing his independence of judgment for an affiliative response from his partner, the high achiever-high in affiliation used his affiliative overtures to get his partner to yield to him and to like him at the same time. When he was under greater stress, however, he could not make as effective a use of his affiliative skills, and his yielding tendencies began to emerge. These results were interpreted as supporting the theory that multiple or "incompatible" motives can be simultaneously satisfied as long as the subject does not experience undue stress.

As additional interpretation, combining the results of this experiment with related studies, hypothesized the probable origins of achievement-affiliation motive patterns.

157 pages. $2.10.

The items following each abstract are: the number of manuscript pages in the dissertation, its cost on microfilm, and the Library of Congress card number. Enlargements 5-1/2 x 8-1/2 inches, 4 cents per page. No postage is charged if check or money order accompanies order.

CONNOTATIVE MEANING AS A DETERMINANT OF STIMULUS GENERALIZATION

(L. C. Card No. Mic 58-1114)

Charles Francis Dicken, Ph.D.
University of Minnesota, 1957

Adviser: James J. Jenkins

This thesis deals with generalization in verbal stimuli which are related in connotative meaning. A two-stage set of theoretical assumptions was experimentally examined, consisting of (1) a theory of secondary generalization based on an hypothesized representational mediation process with which connotative meaning is identified, and (2) a set of assumptions concerning the validity of a measuring instrument, C. E. Osgood's Semantic Differential, in measuring the connotative meaning of verbal signs. Semantic Differential scale profiles on words which had been previously studied were used as the basis for determining connotative meaning, and similarity of connotative meaning was defined by a quantitative index of semantic profile similarity.

Six experimental studies using college student subjects were conducted in an examination of the hypothesis that stimulus generalization will occur between stimuli which are similar in connotative meaning. A lever-pressing response was taught to stimuli which consisted of half of the members of each of four clusters of meaningfully similar words. Generalization was subsequently measured to the remaining members of each word cluster. The series of experiments included replication of stimulus items, alteration of the verbal context of the stimuli used, and exact replication of two experiments with new subjects. Two supplementary studies were conducted with independent subjects: (1) A study of word association habits relating the stimuli used in the generalization studies, and (2) a study of judged meaning similarity in these stimuli which attempted to provide an approximate measure of similarity in denotative meaning. The effects of two additional variables, meaningfulness and frequency of usage were also analyzed.

The predicted generalization effect was obtained in each of twelve analyses of response to clusters of generalization stimuli, substantiating the major hypotheses of the study. Wide variability in response to individual generalization stimuli was observed which could not be accounted for in terms of the connotative meaning variable. A subset of generalization stimuli was identified for which response did not exceed response to control words, in spite of the theoretical equivalence of these stimuli and the others. The later portion of the experimental studies and the supplementary analyses were directed toward discovery of variables other than connotative meaning which related to the obtained differences in response to generalization stimuli. Meaningfulness, defined in terms of the deviation of a word's scale value from the midpoint of the Semantic Differential scales, and judged meaning similarity were identified as variables relating to these differences in generalization. Frequency of usage and word association did not relate to the obtained generalization.

The results were interpreted as confirming the major hypotheses. The mediation hypothesis as an explanation of secondary generalization was considered substantiated. The capacity of the Semantic Differential in measuring meaning similarity was also considered substantiated, although the validity of the instrument in selecting functionally similar stimuli which exhibit generalization was interpreted as not fully satisfactory in view of the obtained results. Improvement of the methods of measuring meaning, further evaluation of variables such as meaningfulness and verbal context, and the development of methods for assessment of denotative meaning were cited as needed improvements in experimental technique.

289 pages. $3.75.

THE APPLICATION OF CERTAIN CONDITIONING AND HANDLING TECHNIQUES TO THE GUIDANCE OF DOWNSTREAM MIGRANT SALMON

(L. C. Card No. Mic 58-1084)

Donald Everett Johnson, Ph.D.
University of Washington, 1957

The effects of exposure to light and to pulsed A.C. electroshock singly and paired in conditioning situations, on the light avoidance behavior of yearling silver salmon was studied by means of a circular tank, any half or all of which could be brought under light, shock or both. The effects of various pretreatments involving handling, tattooing and the use of certain drugs on the readiness of acquisition and retention of certain behavior modifications related to the light avoiding response of yearling silvers was studied by means of a shuttlebox, either half of which could be brought under light or pulsed A.C. electroshock or both.

In the experiment with the circular tank, one hundred forty-eight fish in seven groups were tested individually after being subjected to different combinations of light and electroshock. Electroshock alone tended to decrease the time spent in the light by the fish. Light alone had no significant effect. Relatively long pulses of light paired with brief, mild electroshock (1 volt per inch) also had no significant effect. Light and a stronger shock paired in an escape situation tended to increase the light avoidance of the fish.

Twenty-five millisecond A.C. pulses of the stronger shock (1.5 volts per inch) centered in thirty-five millisecond pulses of light significantly reduced the time spent in the light. The greatest reduction in time spent in the light was achieved with two pulses of the stronger electroshock in the light given in such a manner that the fish could not reenter the light once it had left it. Each of ten fish shocked in the dark until it entered the light, no return to the dark being permitted (for a total of twenty trials), made one alternation from dark to light thereafter without shock. None of ten control fish made such an alternation.

In the experiment with the shuttlebox six hundred fish in eight groups were given pretreatment involving either anesthetization, tattooing or handling, then exposed to various combinations of light and shock. These fish, together with a like number of controls, were tested individually. The effect of shock alone was to reduce the total number of alternations (from light to dark) and the total number of fish making at least one alternation for the experimental fish somewhat below the corresponding values for the controls. Exposure to light alone resulted in scores

very similar to those made by parallel controls. Fish shocked in the dark would not successfully alternate from dark to light, but their alternation scores for light to dark alternation were considerably below those for their parallel controls.

Every group of fish given shock showed an impaired physical condition 192 hours after exposure to shock. This effect had not been expected to persist so long.

Both anesthetization (with urethane or TCM) and extreme handling (tattooing) appeared to increase the light avoidance of yearling silver salmon beyond the increment induced by paired light and electroshock, and the effect persisted for about 96 hours. Anesthetization and handling seemed to exert their influence more or less independently. The intended function of anesthetization is to reduce the traumatic effects of handling; that it should have produced its own increment in light avoidance is somewhat surprising.

The conditioning of single yearling silver salmon to the avoidance of a darkened area in a tank was achieved in twenty exposures or less by means of a punitive electroshock paired with the onset of darkness. With large groups of fish (and the resulting variability in exposure) the effects of electroshock and of handling tended to obscure the evaluation of the conditioning procedures.

113 pages. $2.00.

PROBABILITY LEARNING AS A FUNCTION OF DATA COLLECTION METHODS

(L. C. Card No. Mic 58-942)

Samuel Shozo Komorita, Ph.D.
University of Michigan, 1957

In recent years numerous studies have been conducted on what might be called "Estes-type" situations. Briefly, in studies employing the Estes-type situation, subjects have been presented two lights which varied in probability of occurrence and the subjects have been asked to predict which light would come on over a number of trials. In general, the results of such studies have indicated that subjects match the probabilities of the stimuli; i.e., they predict in accordance with the actual frequencies of the lights so that if the probability of one of the lights is .75, the subject chooses this light on 75% of the trials.

There were two main purposes of this study. One was to determine some of the situations to which matching behavior could be generalized. The majority of studies have been restricted to two-choice situations where one of the lights came on on each trial. Two procedures which were used to extend the situation were: a) the use of a three-choice situation, and b) the occurrence of more than one light on each trial.

The second major problem was the determination of whether different methods of data collection, equivalent from a logical standpoint, would yield equivalent empirical results. These different methods of data collection consisted of asking the subjects to a) pick one of the lights which they thought would come on, b) pick two of the lights which they thought would come on, and c) pick one of the lights which they thought would not come on.

A number of mathematical models were constructed which could make predictions in such complex situations and an attempt was made to determine how well the models would predict the data. These models were the Matching, ahd Adjacent, the Average, and the Maximum Gain models.

Six experimental groups consisting of fifteen subjects each were presented three lights with different frequencies of occurrence. These six groups differed with respect to the frequencies of the stimuli and the instructions given to them.

The frequency of responses to the most frequent stimulus was analyzed by t and F tests. The results indicated that if the primary concern is with responses to only the most frequent stimulus the Matching model and the Adjacent model seem fruitful for probability learning. In addition, the results seemed to indicate that methods of data collection which are logically equivalent yield equivalent empirical results.

The different methods of data collection are discussed and an explanation is offered to account for the results in terms of psychological processes underlying a person's responses in situations similar to the one investigated in this study. 106 pages. $2.00.

THE EFFECT OF CINGULECTOMY ON FEAR

(L. C. Card No. Mic 58-972)

Ephraim Peretz, Ph.D.
University of Michigan, 1957

Chairman: R. A. McCleary

The present series of experiments, concerned with the effect of central nervous system ablation on fear, investigated the behavior of rats which were subjected to bilateral ablation of the anterior cingulate cortex.

Experiment 1. The cingulectomized group (N=11) and a sham-operated group (N=10) were trained to avoid an electric shock, in a modified Miller avoidance box. The cingulectomized group required a greater number of trials to acquire the avoidance response, and had longer response latencies, than did the sham-operated group. The extinction procedure differed from that of acquisition only in that shock was omitted. No difference was found between the two groups in the number of trials necessary for extinction.

Experiment 2. Since it was possible that the poorer performance of the cingulectomized group on the acquisition of the avoidance response was due to intellectual loss, both groups were then tested on the acquisition of a visual discrimination under hunger motivation. The assumption was made that the discrimination problem, in which the animal had to select the alley which led to food, was at least as difficult an intellectual task as was the avoidance problem. The cingulectomized group (N=10) acquired the visual discrimination more rapidly than did the sham-operated group (N=7).

Experiment 3. At this point, it was possible that recovery of intellectual function had occurred in the time elapsing between experiments 1 and 2, and thus it had to be shown that differences in avoidance behavior between the cingulectomized and sham-operated groups were still

present. The cingulectomized group (N=11) and the sham-operated group were submitted to avoidance training, in which the procedure and apparatus were similar to that of experiment 1, but in which oscillation of one compartment replaced shock. It was found that the cingulectomized group acquired the avoidance response more slowly, and had longer latencies of avoidance, than did the sham-operated group (N=7). However, extinction of the avoidance response was more rapid for the sham-operated group than for the cingulectomized group.

Experiment 4. It then was of interest to determine whether cingulectomy produced a decrease in the strength of all drives. The cingulectomized group (N=11) and the sham-operated group (N=6) were deprived of food and placed in a compartment, where they could obtain food by pressing a bar. The bar-pressing rate was higher for the cingulectomized group than for the sham-operated group.

Experiment 5. To test the possibility that the shock-avoidance effects found in experiment 1 for the cingulectomized group, might result from ablation of cortical tissue regardless of locus, two groups of rats with control-lesions were prepared. One group sustained lesions in the parietal cortex (N=5), while the other sustained lesions in the precentral agranular cortex (N=5). Using the procedure and apparatus of experiment 1, it was found that the rate of acquisition of the shock-avoidance response and the avoidance latencies of the control-lesions groups did not differ from those of the sham-operated group in experiment 1.

The locus and extent of the lesions were verified by histological reconstruction.

The differences between the behavior of the cingulectomized group and the sham-operated group in experiments 1-4 can be accounted for, if it is assumed that cingulectomy produces a decrease in fear, and if it is assumed that the extinction procedure was not adequate for the measurement of the decrease in fear. The results of experiments 2 and 3 rule out the possibility of intellectual loss as a factor in the slower acquisition of the avoidance response by the cingulectomized group. Experiment 4 shows that the effect of cingulectomy is not one of general motivational loss, and the results of experiment 5 are evidence that the effects on avoidance behavior found after cingulectomy, are not due to general cortical insult. 52 pages. $2.00.

CUTANEOUS SENSITIVITY TO PULSE ELECTRICAL STIMULI

(L. C. Card No. Mic 58-586)

William R. Uttal, Ph.D.
The Ohio State University, 1957

In an attempt to study the basic psychophysical and physiological variables involved in electrical pulse stimulation of the cutaneous receptors, the skin of the forearm was stimulated with the output of a pulse generating system. The stimuli ranged from 10 microseconds to 10 milliseconds, and were applied either through an attenuating resistor or at varying voltage levels. A single pulse was applied under all experimental conditions except in a study of latent addition, in which two sequential pulses were used. Thresholds were determined by an ascending method of limits in terms of either the series resistance of voltage level.

A Fourier analysis was performed, and a correction for impedance changes as a function of frequency components was applied to the data for the relationship between duration and threshold amplitude. The data were shown on the basis of this correction to approach an intensity-duration reciprocity law within the interval 30 microseconds to 1 millisecond. For pulse duration longer than 1 millisecond the critical duration is exceeded, and hence a reciprocity relation no longer holds.

Experiments were also performed to determine the locus of stimulation. Results of these studies demonstrated that there is no observable latent addition of two subliminal stimuli even when they are separated by an interval as short as 0.2 milliseconds.

Furthermore, it was shown that the dynamics of the electrical threshold were closely associated with the disappearance of touch sensitivity under anoxic conditions produced by a sphygmomanometer cuff. The change in electrical threshold also showed an early hypersensitivity that has been previously associated with A fibers.

These data in conjunction with references to studies which showed no effects on the electrical threshold from local anesthesia by cocaine or ethyl chloride, as well as a consideration of the relative thresholds of the different fiber sizes, lead us to the conclusion that the locus of stimulation is the large A fiber. 67 pages. $2.00.

SOME FACTORS IN CONDITIONING THE PUPILLARY RESPONSE: THE RELATIONSHIP BETWEEN PUPILLARY CONDITIONING AND SHOCK, PGR AND PUPIL REACTIVITY

(L. C. Card No. Mic 58-642)

Alexander Van West, Ph.D.
New York University, 1957

The problem was to explore some of the factors involved in pupillary conditioning. Specifically this study was concerned with conditioning of the pupillary response to a double stimulus, sound and shock, and the relationship of the GSR to pupillary conditioning. The possibilities that such a relationship existed was brought out in previous research.

Twenty subjects were given fifteen (15) presentations of sound plus shock (conditioned stimulus) followed .5 seconds later by either onset or offset of a light (unconditioned stimulus). The tone signaling the onset light was the same frequency as the tone signaling the offset of the light, however the amplitude of the first was twice the amplitude of the second so that they were easily distinguishable by the subjects. Photographic recordings were made of trial 1, 2, 7, 8, 14 and 15. Each trial was 12 1/2 seconds long with an average 45 seconds rest between trials. During each trial approximately 100 pictures were taken making a total of 600 per subject or 12,000 for the total group of twenty subjects. These were all plotted in a series of graphs and responses analyzed in terms of latency, amplitude and rates of contraction and dilations.

The galvanic skin response to the shock was also recorded in milliamperes. The variables computed were amplitude of response and rate of decay.

RESULTS AND CONCLUSIONS:

Of the twenty subjects three conditioned to both contraction and dilation. Twelve conditioned to dilation alone and five showed no signs of conditioning to either contraction or dilation. There were no subjects who conditioned to contraction alone. The criteria was as follows: The subjects responses were broken up into two periods: A control period (the one second of time preceding the tone): and the conditioned period (the one second of time following the tone but before the onset of the light). If the subject's eye contracted during the conditioned period #1 so that it was one millimeter smaller in diameter than at any point during the control period #1 of that run, the subject was said to have been conditioned to contractions. If the subject's eye dilated during the conditioned period #2 so that it was one millimeter larger in diameter than at any point during the control period #2 of that run, the subject was said to have conditioned to dilation. This criteria was met consistently by only one of the twenty subjects. In the rest of the subjects that conditioned (showed a change in pupil) the response occurred only once or twice in the six recorded trials. It may be argued, therefore, that the results obtained could have occurred by chance. The fact that no conditioning occurred consistently, with the exception of the one subject mentioned above, is the most damaging evidence against the assumption that conditioning was obtained. This argument may be countered with the following facts. First, that the three groups showed definite differences significant to the 2% level of confidence in the rate of pupillary contraction. Those who conditioned to contraction and dilation showed an average contraction rate which was twice as fast as those who did not condition at all. While those who conditioned to dilation alone showed speeds of contraction which were approximately half way between the fast reaction of the conditioners and the slow reaction of the non-conditioners. The second fact arguing against the results being due to chance was that the rate of decay of the GSR was significantly different to the .01 level of confidence of the three groups. Those subjects that manifested pupillary conditioning recorded a decay rate on the galvanic skin response that was twice as fast as the decay rate of those individuals who showed no pupillary conditioning.

The general implication here seems to be that those subjects whose autonomic system is such, that it reacts quickly when stimulated tend to condition. Those subjects whose autonomic response is relatively slower, do not show signs of pupillary conditioning. 71 pages. $2.00.

A STIMULUS-TRACE HYPOTHESIS FOR STATISTICAL LEARNING THEORY

(L. C. Card No. Mic 58-1310)

Robert Samuel Witte, Ph.D.
Stanford University, 1958

By assuming that the trial stimulus contains a trace of the previous reinforcing event, one can apply statistical learning theory to verbal conditioning and T-maze studies in which sequential dependencies exist between successive rewards. According to the theory, terminal conditional response probabilities should match the sequential dependencies between rewards only when the trial spacing is massed. When the trial spacing is sufficiently distributed and the sequential dependencies between rewards are symmetrical, these probabilities should approach a value of approximately .50. An attempt was made to test the model by varying the size of the intertrial interval and noting its effect on conditional response probability.

The Ss were 159 rats, each of which received from 200 to 400 trials in a simple T-maze. Each S was assigned permanently to one of four intertrial intervals: 8 seconds, 30 seconds, 3 minutes, and 1 hour. To adjust for the possible effects of alternating tendencies, one half of the experimental Ss worked under a "block" reward schedule consisting of comparatively long runs of E_1 and E_2 events, while the remaining experimental Ss worked under an "alternating" reward schedule consisting of extremely short runs of E_1 and E_2 events. As an additional check on alternation tendencies, a control group worked under a sequentially independent reward schedule.

The following was found:

1. The response data for the control Ss indicated the presence of strong reward and response alternating tendencies. Alternation with respect to the previous reward occurred more frequently than alternation with respect to the previous response. No consistent relationship existed between the reward and response alternating tendencies of individual Ss.

2. Slightly more than 50% of all of the Ss developed position preferences. These preferences occurred more frequently under the alternating reward schedule and under distributed trial spacing. Since the theory could not be adjusted readily for the large incidence of Ss with position preferences, these Ss were excluded from all subsequent analyses.

3. The terminal conditional response probabilities for the Ss under the block and alternating reward schedules differed significantly, but this difference was in the direction anticipated by the experimental correction for reward alternation tendencies.

4. The terminal conditional response probabilities for the Ss at each intertrial interval differed significantly in the direction predicted by the theory, i.e., terminal conditional response probability approached a value of .50 as the intertrial interval became large. The theory adequately described changes in terminal conditional response probability at the massed and distributed ends of the trial spacing continuum, but it overestimated changes in conditional response probability at the middle of the continuum when the intertrial interval equaled 3 minutes. The magnitude of this overestimation was reduced considerably by introducing adjustments for stimulus overlap and response alternation tendencies. 64 pages. $2.00.

THE RELATIONSHIP OF THE EARLY LUTHERAN HYMNS TO CERTAIN FEATURES OF MARTIN LUTHER'S THEORIES OF RELIGIOUS EDUCATION

(L. C. Card No. Mic 58-653)

William Armond Kelley, Ph.D.
New York University, 1957

This study deals with the relationship between the early Lutheran hymns and certain features of Martin Luther's theories of religious education as these are found in his writings of religious educational importance. With regard to these features, the investigator considered, in particular, Martin Luther's religious doctrines and his religious educational methods. In the case of the latter, -- that is, Luther's religious educational methods -- these were studied and discussed in a manner such that the characteristics and emphases found present therein might be correlated with the usage or employment of the hymns (also considered in terms of religious educational method) within the religious educational enterprise.

Concerning the doctrines, the hymns and Luther's writings of religious educational importance were analyzed or studied and correlated in terms of the following doctrinal views:

God
Christ
Trinity
Holy Spirit
Grace
Creation
Faith
Justification
Word
Man

With regard to the characteristics and emphases of religious educational method, the following list was, after having been established, used as the basis for studying and correlating the usages of the hymns (considered in terms of religious educational method) and the characteristics or emphases found in Luther's writings of religious educational importance:

Creativity
Democratic
Personal Religious Experience and Insight
Transformation
Freedom
Socially-Centered Contribution
Rounded Christian Religious Education

The results of this study indicate 1) that the doctrines found in both the hymns and Martin Luther's writings of religious education importance are quite complete and find a high degree of correlation, and 2) that the correlation of the usages of hymns (considered in terms of religious educational method) and Luther's religious educational methods (as found in his writings of religious educational importance) also demonstrate a high degree of relatedness. This relatedness, of course, is demonstrated on the basis of those religious educational characteristics and emphases of which mention has been made above.

The general conclusion is that with regard to the doctrines as well as the religious educational characteristics or emphases considered, we may assume with reasonable confidence that there is a high degree of relationship between the early Lutheran hymns and the features of Martin Luther's theories of religious education (as these are found in his writings of religious educational importance).

These findings, moreover, lend reassurance to those now endeavoring to make more extensive use and study of the hymns in the religious educational enterprise. They also tend to clarify the relevance and relation of hymnody to Christian religious educational procedures as a whole.

332 pages. $4.25.

AN APPRAISAL OF THE OPPORTUNITIES FOR SUPERVISED FIELD WORK IN CHRISTIAN EDUCATION WITH CHILDREN AND YOUTH IN THE SEMINARY TRAINING OF THE MINISTRY

(Publication No. 24,934)

Dorothea Kathryn Wolcott, Ph.D.
Northwestern University, 1957

The value of practical experience in theological education has been considered in several studies in the past twenty years. However, there has been little emphasis on Christian education in field work and no analysis of the opportunities for seminarians to have experiences with children and youth.

Problem. The present investigation appraised the nature and extent of supervised field work as offered in seminary training. A specific goal was to identify the scope, sequence, and character of activities offered in field experiences with children and youth.

Procedure. To ascertain the current practices in seminary training, those schools affiliated with the American Association of Theological Schools were sent questionnaires. Fifty seminaries supplied sufficient information to be used in the study.

Thirty per cent of the graduates of the class of 1952 in the contributing seminaries responded to similar inquiries. The majority of these were ministers, directors of religious education, chaplains, professors, missionaries, and denominational leaders.

Findings. The results of this investigation are:

1. Ninety-four per cent of the fifty schools required field work for graduation. Thirty-nine per cent of the students enrolled in 1955-56 in 47 schools were engaged

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in supervised field work in Christian education. The majority of the seminaries required two semesters of field work, although forty per cent of gruduates had taken three years on an elective basis.

2. There was a closer correlation between field work and regular seminary courses than had been evident in earlier studies, especially in practical theology and Christian education. Thirty-three per cent of the graduates had field work related to a seminary course.

3. Forty-five of the seminaries reported that they attempted to provide for student's individual needs as opportunities were available in field work, but only twenty-eight per cent of the seminaries had attempted to match student's growth needs with field experiences.

4. More adequate supervision is needed to select the most beneficial field work for the student's professional growth. Forty-four seminaries placed students in field work but three-fifths relied upon churches to supply positions.

5. One-half of the graduates reported having worked with youth while only one-third had guided children's activities. Some had had experiences with both age-groups.

6. One-half of the seminaries employed full-time field work directors, while two-fifths expected professors to supervise field work in addition to their regular teaching load. Sixty-eight per cent of the seminaries depended upon the churches involved for supervision. Forty per cent of the graduates indicated that ministers had supervised their field work. Over half of the graduates reported that they had not been observed. Thirty-seven per cent of the graduates regarded inadequate supervision as the weakest aspect of field work.

7. Thirty-eight of the fifty seminaries required written reports from the students and churches as a basis for evaluating field work. Twenty-five of these expected such reports once a term while one-third required them weekly. Thirteen seminaries planned conferences with church supervisors. Almost half of the graduates reported that no provision had been made for regular evaluation of their field work.

Conclusions. This study emphasized the need for better integration of field work with the seminary curricula. To meet the needs of the students, it is imperative to select experiences in field work that will foster individual growth. Greater variety of experiences in field work is needed to develop the student's abilities in relation to various age-groups and the educational work of the church. Increased supervision under the guidance of specially trained field directors is essential for effective learning experiences. Continuous evaluation of the seminarian's experiences is necessary. 359 pages. $4.60. Mic 58-4847

SOCIAL PSYCHOLOGY

INTERACTION OF SOCIOECONOMIC CHARACTERISTICS AND REFERENCE GROUPS WITH RESPECT TO VOTING BEHAVIOR

(L. C. Card No. Mic 58-1387)

Homer Chassell Cooper, Ph.D.
University of Michigan, 1957

Chairman: Professor Angus Campbell

The central problem of this dissertation was: how is an individual's voting behavior affected by the interaction of his reference groups and his socioeconomic positions? The reference groups selected for study were the political party and social class to which an individual assigns himself; self-perceived memberships in these two reference groups were hypothesized to be motivational forces acting upon the individual and important determinants with regard to voting. The objective socioeconomic variables consisted of income, education, and occupation. The cross-pressures hypothesis of Lazarsfeld and his associates was conceptualized as conflicting multiple motives interacting within any individual whose reference group memberships and socioeconomic positions are heterogeneous rather than homogeneous. In addition, a theory conceptualizing the relationship of perceived and objective social class positions in terms of mobility aspirations was presented and predictions concerning the political relevance of this relationship were tested.

The specific hypotheses arising from this theoretical framework were (1) reference group memberships and socioeconomic positions are independent co-determinants of voting behavior; (2) cross-pressures will be induced by heterogeneous socioeconomic positions among persons with the same reference group memberships; and (3) cross-pressures will be induced by heterogeneous reference group memberships among persons with the same objective socioeconomic positions.

The data used to test these hypotheses were collected by the Survey Research Center of the University of Michigan in 1614 national sample pre- and post-election interviews pertaining to the 1952 presidential election. The sample of respondents was selected by the Center's stratified area probability method which provided a representative cross-section of citizens of voting age living in private households in the United States. A detailed description of the procedures used in obtaining the sample can be found in an appendix to The Voter Decides by Campbell, Gurin, and Miller.

The findings were: (1) among persons occupying the same socioeconomic positions, political party identification and perception of social class are important determinants of vote, and cross-pressues are induced when these reference group memberships are heterogeneous; (2) among persons assigning themselves to the same reference groups, positions on income, education, and occupation are not determinants of vote, and cross-pressures are not induced when these socioeconomic positions are heterogeneous; and (3) voting behavior is influenced more by direction and intensity of party identification than by perception of cosial class membership, and the latter in turn is a more efficacious predictor of voting than is knowledge of occupation, income, or education.

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These findings supported the conclusion that reference group memberships are more immediate determinants of behavior than are socioeconomic positions; the former appear to act as internal motivational forces, whereas the latter seem to be indexes of an external normative environment which is not necessarily incorporated by a given individual. It was suggested that future studies of elections should examine the following reference group dimensions: intensity of identification, political relevance, psychological function served, and perceived locus of control.

150 pages. $2.00.

THE NORMATIVE STRUCTURE OF SOCIAL SYSTEMS: A STUDY OF ORGANIZATIONAL EFFECTIVENESS

(L. C. Card No Mic 58-917)

Basil Spyros Georgopoulos, Ph.D.
University of Michigan, 1957

The problem of this empirical investigation is the relationship between group norms and organizational effectiveness. The underlying social-psychological principle is that much of human behavior, whether of individuals or of organizations, is determined by group norms. The general proposition examined is that the effectiveness of a large, complex organization can be predicted from certain normative variables. Several such variables are conceptually distinguished, in a manner that relates them to one another theoretically: (1) "normative complementarity," or the degree to which certain expectations concerning the application of organizational pressures are shared by supervisors and their subordinates; (2) "member-activeness," or the degree to which group members can influence norms regarding the operations of the organization; (3) "normative consistency," or the degree of similarity between prevailing and corresponding desired group norms; (4) "group consensus," or attitudinal similarity (agreement) concerning norms associated with high organizational effectiveness; and (5) "normative clarity," or the degree to which norms are understood by the group members.

The data for the measurement of the above variables were gathered through a survey questionnaire. This was administered to the respondents as part of a more extensive field study conducted by the Human Relations Program of the Survey Research Center, Institute for Social Research. A sample of thirty-two groups was used. All groups were member-units of a nation-wide, unionized service industry, each operating at a different geographical location. Each such group, formally designated as a "station," was used as the basic unit of analysis and hypothesis testing. For each hypothesized relationship, two measures of organizational effectiveness were used: (a) actual station productivity obtained from organizational records and (b) a special management evaluation of the overall effectiveness of each station. The analysis was carried out by means of correlational techniques, t-tests, tests of proportions, and analysis of variance.

The main findings of the study were that organizational effectiveness varies with each of the following: (1) normative complementarity, (2) member-activeness, (3) normative consistency, and (4) group consensus. No relationship was found between organizational effectiveness and the clarity with which norms are understood by the group members.

The findings suggest that the study of organizational effectiveness can be illuminated by a theoretically integrated analysis of group-norm variables. There are indications that a similar approach may be usefully extended to the study of other phenomena in the area of social organization and to other kinds of social systems.

177 pages. $2.35.

MEASURING INDUSTRIAL LEADERSHIP AND ITS IMPLICATIONS FOR TRAINING SUPERVISORS

(Publication No. 25,444)

Edwin Francis Harris, Ph.D.
The Ohio State University, 1952

Our present civilization is based upon an industrial economy; as such, its growth has depended upon advances in industrial potential and capacity. Future growth similarly is contingent upon increased expansion of our industrial potential. In the last fifty years the knowledge of the psychologist has been recognized as an instrument which might be used for improving industrial performance through adequate selection, placement, and training of workers, but it is only recently that the role of the leader in increasing work efficiency has been experimentally studied. A survey of the literature reveals a great many opinions and hypotheses but few empirical results.

Background and Purpose

The study constitutes the second of two parts which were carried on under an International Harvester Research Fellowship. The first part was conducted by Doctor E. A. Fleishman and concerned itself with the standardization of leadership instruments as originally developed for an Air Force Population. Such revised instruments were then used in the evaluation of a training program. In general, his results showed that the training program was not meeting its objective of making the trainees more human-relations oriented in the plant situation. This left two alternatives open: 1. attempt to change the training course so as to achieve the stated goal of the increased human relation orientation of the trainees, and 2. investigate the effects of different types of leadership and determine their effects upon foreman efficiency. This would lead to a more systematic evaluation of the effects of training. Since the latter course was preferable, it set the pattern of the study.

Therefore, the purpose of the study was to investigate the relationships between leadership behavior on the part of the foreman and various measures or criteria or work efficiency.

In addition, the effects of a refresher training school at Wittenberg College upon leadership behavior, attitudes, and expectations on the part of the foreman were noted.

Methodology

The methodology for determining the relationships between leadership behavior and work efficiency involved several steps:

1. Administration of questionnaires.
2. Determining the stability of leadership patterns over a period of time set aside for the collection of criteria material relating to work group behavior.
3. Identifying and eliminating those foremen from the sample who were not also the functional leaders of their work groups.
4. Determining the degree to which a small sample of each foreman's work group might be representative of the descriptions given by an entire work group.
5. Specifying criteria and identifying and eliminating contaminating factors when present.

The problems will be discussed in the above order.

Administration of questionnaires

Seven questionnaires designed to measure leadership attitudes, expectations, and behavior were administered to three distinct groups, i.e. workers, foremen, and men named by the foremen as their supervisors. Each of the groups received the following questionnaires:

1. The 561 workers received:

a. The Foreman Behavior Description questionnaire, a forty-eight item form in which the worker described the leadership behavior of his foreman.

b. A forty item questionnaire entitled How You Expect an Ideal Foreman to Act in which he described his conception of an ideal foreman.

2. One hundred and twenty-six foremen filled out the following three questionnaires:

a. Foreman's Leadership Opinion Questionnaire in which the foreman describes what he thinks he as a foreman should do as a leader for his group.

b. A forty item form entitled What Your Boss Expects of You in which each foreman describes the leadership behavior which his boss expects of him.

c. Lastly, all foremen filled out the Supervisory Behavior questionnaire in which they described the leadership behavior of their own supervisors.

3. The last group, consisting of thirty-six men named by the foremen as their own supervisors, filled out the following two questionnaires:

a. A forty item questionnaire entitled What You Expect of Your Foremen in which the supervisor described his expectations concerning the leadership behavior of the foremen under him.

b. A forty item Leadership Opinion Questionnaire in which the foremen's supervisors describe how they think they should lead the foremen under them.

Each instrument was scored along the two, factor-analysis, determined leadership dimensions of "consideration" and "initiation of structure." These dimensions may be roughly defined as--consideration: the extent to which the leader is considerate of the feelings and attitudes of the men under him; initiation of structure: the extent to which the foreman structures the work relationships, i.e. plans, organizes, and directs, the activities of the work group toward production.

The scores of the Foreman Behavior Description questionnaire were used in the criteria study, and the rest of the questionnaires were used primarily in the evaluation of the training program at Wittenberg College.

Determining Stability of Leadership Patterns

The stability of the leadership patterns was determined by means of an analysis of the scores of ninety-eight foremen who were present in both administrations (separated by an eleven month interval) of the questionnaires. The resulting analysis showed sufficient stability to indicate that there was no serious error due to fluctuating behavior patterns.

Identifying Functional Leaders

Those foremen who were not functional leaders of their work groups were identified by building into the administration of the questionnaires a nominating technique by which the workers could identify those foremen from whom they took most of their orders. Those foremen who were not nominated by the members of their work groups were considered structural but not functional leaders and so were dropped from that part of the criteria study which involved the relationships between group behavior and leadership.

Representativeness of Behavior Descriptions

This problem of determining to what extent the descriptions of a foreman by a small group of workers was representative of what might have resulted if the entire group had described each foreman was determined by computing a coefficient of inter-rater agreement among those workers who were used. Since the sample is a random one, the resulting coefficient was interpreted as the reliability between all workers. Since the coefficients were low (.55 for consideration and .50 for initiation of structure), it was believed that the generalization on this score to all members of a work group would involve considerable additional error. Therefore, when possible (with absenteeism and accident rates), only those men who described the foremen were considered when indices of group behavior were computed.

Criteria

The final problem, that of specifying criteria and identifying and eliminating sources of contamination when present, was conducted in the following manner:

The plant records and plant personnel were consulted for possible criteria. Criteria were accepted or rejected on the basis of: 1. Completeness of recording, 2. Presence or absence of contaminating factors which could be neither measured nor controlled. In the final analysis six criteria were used. Four were taken from plant records (absenteeism, accident, grievance, and turnover rates), the fifth from the foremen's work groups (scaling of the items on the Foreman Behavior Description questionnaire along the dimension of how well workers like working for a foreman who displays varying amounts of the leadership dimension), and the sixth from responses of the foremen's supervisors (global ratings of proficiency).

In an attempt at identifying sources of contamination in the measures of group behavior, absenteeism, grievance, turnover, and accident rates were related to education, skill, seniority, methods of pay, age, marital status, hazards of the job, and pleasantness of working conditions. The general method consisted of inter-correlating the above measures and the criteria measures. The matrix was cluster analyzed, and those factors were noted which contained the criteria variables. The other personal and job factors which had large loadings on the same factors as the criteria variables were partialled out.

In general the partialling process consisted of computing the factor score on which the criteria and personal and

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job factors had high loadings, and partialling the effects of contamination by partialling the factor score.

The effects of the training program were evaluated by constructing an experimental group (a group which had had the training) and a control group (a group which did not have the training), and noting the differences between their behavior as described by their work groups, as well as the foremen's attitudes and expectations. In addition, changes were noted within each group on "pre and post" administration of the same questionnaire. Each of the groups has thirty-two foremen who were matched on a number of personal and plant factors, as well as on the first administration scores for those questionnaires in which change was noted.

The following pages will present the results.

Results

1. The results of the scaling of the items by the workers along the dimension of like or dislike showed that workers like working under foremen who show a high consideration score (.96) and they dislike working under foremen who structure highly (-.48). Both of the correlations were significant beyond the one per cent level of confidence.

2. The ratings of foreman proficiency as given by the foremen's superiors revealed several interesting trends.

a. Non-production and production groups were sufficiently dissimilar so that they should not be combined into one sample. This conclusion was based on the results of an intradivisional analysis which showed that in production divisions proficiency seemed to vary directly with structure and inversely with consideration. In the non-production groups the trend was reversed and proficiency varied directly with consideration and inversely with structure. A further analysis suggested that one of the underlying differences may be the "demandingness of their time schedule," that is, the degree to which each group must work against a "demanding time schedule."

When the groups were combined into larger samples, groups corresponding roughly to production and non-production units were constructed so that the above distinction was maintained. Subsequent correlation analysis within each of the groups showed that in only one instance was leadership behavior significantly related to proficiency and that correlation (.29) was between proficiency and structuring behavior in the production groups. For further analysis one of the production divisions was dropped since it was somewhat unique in its emphasis upon a reduction of an excessive grievance rate. When this was done the resulting correlations in this group rose to .46 between proficiency and structure, and -.27 between consideration and proficiency. Both coefficients are significant at or beyond the five per cent level of confidence.

The above analysis suggested the advisability of dropping the non-production groups. The remaining analyses, except when otherwise noted, were based upon production divisions.

3. Three significant relationships were noted in the group behavior measures. All relationships are expressed in terms of first order partial correlational coefficients with the effects of the factor score partialled to remove contamination from the criteria.

Neither accident rate or turnover rate correlated with either of the leadership dimensions when the production groups were considered. On the other hand, absenteeism rates correlated significantly with initiation of structure (.27) and with consideration (-.49). Thus, the higher the consideration and/or the lower the structuring score of the foreman the lower his absenteeism rate. Grievances correlated .45 with initiation of structure. Thus, the higher the structuring score of the foreman the higher the grievance rate of his work group.

A somewhat similar analysis was made of twenty non-production foremen. No attempt was made at correcting the criteria for sources of bias because of the relatively small number. However, some comparisons may be drawn between the two groups. The resulting analysis showed that accident rate and turnover showed significant correlations while absenteeism and grievance rate showed a lesser and non-significant relationship with the leadership dimensions. Thus, accident rate correlated significantly with consideration (-.42), and grievance rates correlated (.51) with structure scores. This is further evidence of the difference between these groups.

4. The evaluation of the training program showed one significant trend - decrease in the degree to which the foremen in the control group showed structuring in their leadership behavior as described by their foremen. The interpretation might be that the effects of the training were to maintain structuring behavior at a previous level rather than allowing it to decrease, as seems the case when no training intervenes.

5. An analysis of the foremen who lost nominations from the work groups as against those who did not lose nominations suggests that the foremen who did not lose nominations differed in that they:

a. stand behind their workers when they are in trouble, and

b. take an active leadership role by instituting their own ideas and encouraging both quality and quantity of production, yet retain flexibility in their dealing with their work group in that they explain the reasons behind their actions and accept and institute ideas presented by members of their work groups.

6. A final overview of the data led to some additional interpretations and hypotheses.

a. The foreman is faced with conflicting standards, viz., the workers like consideration and the foreman's superiors implicitly like structuring behavior because they relate it to proficiency. Furthermore, if the foreman adheres to company standards, his absenteeism and grievance rates increase, and if they become excessive, he is subjected to censure from those who encourage that type of structuring behavior.

b. Change as a result of training, as presented by Fleishman, was interpreted in terms of degree to which the worker identified himself with either management or his work group. If the foreman identified with his work group, he would conform to their standards and show greater amounts of consideration than those foremen who identified with the company; and if he conformed to company standards, he showed less consideration and greater structuring behavior. It was hypothesized that foremen tended to identify more closely with management after attending the central training school in Chicago than they did prior to attending. A gradual re-affirmation of older identification with work groups, then, accounts for the lack of significant differences between the trained and the untrained groups after some time has elapsed after training.

c. The concept of training the foreman to "structure

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considerately" was advocated as a possible way of combining the somewhat conflicting demands made upon the foremen by management and their work groups. In line with this, several areas were suggested in which structuring behavior might be most profitably changed to conform to the above concept. Thus leadership in the general area of methods, standards, and procedures of work appeared from the scaling procedures to be those structure areas in which the workers had the least, if any, objection.

d. An examination of the pre- and post-scores of the foremen who were present in both administrations of the questionnaire as well as those who took part in the training study shows that there is a tendency for the foremen who have had training to show a lower agreement with their previous scores than those foremen who had no such training between administrations. The trend is shown by the correlation coefficients rather than differences between means. Perhaps the results reflect individual differences between the foremen and the conditions in the plant under which they must operate. Some type of clinical analysis might throw some further interesting light on these points.

Further Research

Many areas of research are suggested. To name a few:

Research into the nature of the training programs, which might throw further light on the relative importance of factors influencing changes in foremen behavior. This is probably the most pertinent area in which work might be done.

Undoubtedly, additional work must be done to establish the generality of the findings. Pending this, the results should be interpreted as being limited to the plant in question. 252 pages. $3.25. Mic 58-4848

Abstract published by special arrangement with The Ohio State University.

HOMOGENEITY OF MEMBER PERSONALITY AND ITS EFFECT ON GROUP PROBLEM-SOLVING

(L. C. Card No. Mic 58-929)

L. Richard.Hoffman, Ph.D.
University of Michigan, 1957

Chairman: Norman R. F. Maier

This research investigated the effects of varying the degree of similarity of personality of group members on the quality and acceptance of the group's problem-solving products.

The Guilford-Zimmerman Temperament Survey was administered at the beginning of each of two semesters to the students in an undergraduate course, Psychology of Human Relations. Using the profile of ten scores obtained from each student, groups of 4 people were constituted in each laboratory section. One Homogeneous and two non-Homogeneous types of groups were formed: (1) 20 Type 1 (Homogeneous) groups, students with high positive correlations (Taus) between their personality profiles; (2) 15 Type 2 groups, students with both high positive and high negative correlations; and (3) 22 Type 3 groups, students with approximately zero correlations. These groups were maintained and role-played together throughout each semester. Only the data from groups wholly intact when the test problems were administered were analyzed.

Two problems provided the dependent measures. For the Mined Road Problem (MRP), the group devised a method for crossing a mined road using material in the area. Scores were assigned to solutions according to their adequacy. The higher the score, the better was the solution. This problem was considered to be an intellectual problem and was designed to measure solution quality. In the Change of Work Procedures problem (CWP), a supervisor and his three subordinates discussed a proposed change in the work method. Three types of solutions resulted: Old - refusal to change; New - acceptance of supervisor's suggestion; and Inventive - combining qualities of both the Old and New solutions. This problem involved quality and acceptance.

Hypotheses and Results

Hypothesis IA On the MRP, non-Homogeneous groups will produce higher quality solutions than will Homogeneous groups.

This hypothesis was confirmed at the .05 level of confidence (one-tailed t-test). The mean of the 17 non-Homogeneous groups (Types 2 and 3 combined) was 63.1; of the 13 Homogeneous groups, 44.5.

Hypothesis IB On the CWP, non-Homogeneous groups will produce either Old or Inventive solutions; Homog-groups, Old or New solutions.

Although 41% of the 17 non-Homogeneous groups produced Inventive solutions to the CWP, and only 17% of the 12 Homogeneous groups produced such solutions, this difference was not statistically significant (chi-square test). The large number of Type 2 solutions in both types of groups shows that the acceptance factor was a strong force in this problem. The difference obtained for the Inventive solutions is in the direction of the results of the MRP and indicates that the quality factor was more important in this problem than was expected beforehand.

Hypothesis II The relation between acceptance and quality of solutions will be zero for Homogeneous but positive for non-Homogeneous groups.

No relationship was found between acceptance and quality on the MRP. Almost all groups (21 of 30) were unanimously satisfied with their solutions. On the CWP a significant relationship was found between producing Inventive solutions and unanimous satisfaction with the solution, but this relationship was found in both Homogeneous and non-Homogeneous groups.

Hypothesis III Homogeneous groups will take less time to solve problems than do non-Homogeneous groups.

The mean times for problem-solving were not significantly different for the Homogeneous (26.2 minutes) and non-Homogeneous (28.0 minutes) groups.

These results support a theory of group behavior in terms of the group characteristics, rather than of the

characteristics of the individual members. They also indicate that groups of people with similar personalities are less likely to be creative than are groups of people with dissimilar personalities. 92 pages. $2.00.

INTERACTION IN FOSTER BOARDING FAMILIES

(L. C. Card No. Mic 58-932)

Dorothy K. Howerton, Ph.D.
University of Michigan, 1957

This study had a double purpose: 1) to explore the value of applying social psychological theory and concepts to a social work problem, and 2) to study some of the group properties of foster boarding families, particularly the interaction of members of the group. Foster boarding parents take non-related children and give them the care and training which children should receive in their homes. The study was undertaken to gain insights into the structure and dynamics of this type of group.

This was a field study of forty-six foster boarding families with three members--foster father, foster mother, and foster child. Home visits were made and information obtained from foster parents by use of questionnaires. Foster parents' replies to one set of questions were compared to replies given by parents of forty-three school children in a current study at the Research Center for Group Dynamics.

Foster parents gave information about the participation of members of the families in deciding about and carrying out a sample of specific activities, including household tasks, social activities, and care of children. They told about changes in activities and in amount of time spent on them following the placement of the child. They were asked about their expectations of boys and girls of various ages and their answers compared to their expressed attitudes toward their foster child. Foster parents also gave information about themselves and their family background.

Four major variables were studied: 1) size of group (including change in roles following change in size) 2) Participation (including interaction in activities and symbiotic relationships), 3) consensus (including both agreement as to perceptions and similarity of attitudes), and 4) cohesiveness (meaning acceptance of the group and the new member).

The findings showed that the attitudes of the central members influenced the roles of the new members of the groups. Roles of foster boarding children were not identical to roles of own children, foster children being kept more dependent, sharing in social activities more than in decisions. Foster parents liked taking care of children, both shared in almost all areas of child care, dividing responsibility on the basis of liking for tasks. Patterns of interaction in decision processes were different for important decisions and day-to-day decisions about tasks. Foster parents said "no one had to decide" more often than natural families. Foster mothers were no more dominant than the mothers of the school children. A positive relationship existed between participation and consensus and the foster parents who participated the most in activities which they liked had the most affirmative attitudes toward their families and their foster children.

Two suggestions result from this study. First, a program of research on foster home placements would seem both feasible and desirable; such a program might best be carried out by an interdisciplinary team of social workers and social scientists. Secondly, many social psychological concepts and theories seem to be useful both for the social work practitioners, as an aid in understanding the phenomena with which they deal, and for the social work theorists who are trying to develop a firm foundation for social work research. 241 pages. $3.15.

THE FACTORS OF ILLNESS AND ENVIRONMENT IN THE READJUSTMENT OF SCHIZOPHRENICS

(L. C. Card No. Mic 58-936)

Charles Higgins Kepner, Ph.D.
University of Michigan, 1957

This study was concerned with the identification and evaluation of the factors related to the successful readjustment of schizophrenic patients. Two factors of the schizophrenic illness itself were considered, illness symtoms and the patient's own perceptions of his fitness and self-adjustment. Two environmental factors were studied, the acceptance accorded the patient by others and the adequacy of the work or activity situation. A fifth variable was the physical condition of the patient. The dependent variable was the achieved adjustment of the patient within the community.

One hundred schizophrenic patients who had been out of hospital for one-half to three years were studied. These patients constituted the total population of discharged schizophrenics from the Munroe Wing, Regina General Hospital, for the period from 1952 through 1955, with the exception of those patients over 55 years of age or under 18. The hypothesis was made that readjustment is a function of the state of the schizophrenic illness itself and is not determined by the factors of the patient's environment. As a test of this, information was gathered from the patients concerning the illness variables and from non-patient sources concerning acceptance, the work situation, and physical health.

Illness variables were found most highly related to objective adjustment, environmental variables only moderately so, and physical health almost not at all. When the effects of other variables had been partialled out, state of the illness factors accounted for more than two-thirds of the determination of adjustment and environmental variables less than one-fourth. The most efficient prediction of adjustment success is to be made from knowledge concerning the state of illness variables and either one of the two environmental variables.

One probable interpretation of the results is that the state of the schizophrenic illness is the basic determiner of success in the readjustment of former patients and that environmental factors are of secondary importance. Environmental factors make adjustment more or less pleasant for the patient, more or less easy, but, except in rare instances, the most favorable environment apparently cannot overcome or compensate for the effect of serious illness. Readjustment may take place in adverse environments and under difficult conditions if the illness itself

has receded. Illness and environment are to a certain extent interactive in the joint determination of readjustment but a favorable state of the illness is the basic and perhaps necessary condition for readjustment while environment is an important modifier of the readjustment process. 140 pages. $2.00.

THE INFLUENCE OF ATTITUDE IN VARIOUS PHASES OF DISCRIMINATION LEARNING

(L. C. Card No Mic 58-1124)

David William Lewit, Ph.D.
University of Minnesota, 1957

Adviser: Ben Willerman

The purpose of this study was to explore an attitude-action relationship under controlled conditions. Attitudes toward geometric symbols were induced in college sophomores by showing them an animated cartoon movie[1] in which a large triangle (T) plays a bully, who molests a dot (d) and a small triangle (t). t is at first beaten, but later rescues d from the clutches of T. Trait ratings of facsimilies of these figures differed somewhat from those of the stereotypical villain, maiden, and hero. But overall evaluations on 13 semantic scales gave t top rating, d next, and T last. Also, recall descriptions of the movie linked t and d in mutual interest.

The three figures appeared as symbols in a delayed reward discrimination learning series. It was expected that attitude-induced Ss would tend differentially to select the top rated symbol in the initial choice of the series. With t rewarded, it was expected that Ss in attitude-induced groups would learn the discrimination faster and that more would reach a pre-extinction learning criterion than Ss in whom the attitudes had not been induced. It was further predicted that attitude-induced groups would persist longer in the selection of t following the withdrawal of reward, and that their alternative choice would be the symbol d socially linked with t.

Results supported predictions concerning learning and alternative choice. Results concerning persistence were too weak to be reliable. Results concerning initial choice were contrary to hypotheses, with d being chosen by a majority of Ss in one attitude-induced group and T being chosen more often than t in all attitude-induced groups. Tendency to select t and not to select d were shown, however, to vary positively with salience of character evaluative set cues presented to attitude-induced Ss before starting the discrimination task.

In another experimental condition, choices of T rather than t were rewarded. Compared to t-rewarded performance in attitude-induced Ss, T-rewarded choice effects were expected to be weaker in all phases of the discrimination series. Results failed to support these expectations reliably. Although behavior in persistence and alternative choice phases was in the expected direction, more T-rewarded Ss learned the discrimination if they were attitude-induced than if they were not. T-rewarded attitude-induced Ss also tended to select t more as an alternative choice than did T-rewarded non-attitude-induced Ss.

With regard to the excess of initial d-choosing, data were offered suggesting that this may be the result of a mechanical, non-character-evaluative set, especially in one movie-exposed group. The excess of T-choosing was argued to be associated with the ambivalent status of both t and T, and with T's dominance in the movie. The tendency in some phases for T to be selected more by attitude-induced than non-attitude-induced Ss was argued to be due to confirmation (by appearance of reward) of positive potentialities in T's mixed character.

In general it may be concluded that attitude does influence rewardable choice, but not independently of set cues and object ambivalence. 180 pages. $2.35.

1. Produced by F. Heider and M. Simmel for "A study of apparent behavior." Amer. J. Psychol., 1944, 57, 243-259.

SOME RELATIONSHIPS BETWEEN ANXIETY, "DEFENSIVENESS" AND FUTURE TIME PERSPECTIVE

(Publication No. 23,107)

Ronald Stewart Lipman, Ph.D.
University of Connecticut, 1957

Statement of the problem: While it appears clear that anxiety is a future-oriented state, the cognitive characteristics of its future time perspective are not yet well understood. Indeed, divergent hypotheses have been advanced. The present study therefore explores the future time perspective manifestations of anxiety in order to: (a) extend our knowledge of its dimensions (b) supplement our understanding of the mechanisms by which it is perpetuated (c) attempt to resolve contradictory formulations regarding its future time perspective characteristics.

Secondarily, it seemed desirable to include the K "defensiveness" scale of the M.M.P.I. since the particular arrangement of the present study promised to yield data pertinent to an evaluation of one of the major interpretations of the K scale, an interpretation which has direct bearing on the validity of one of our basic measures--the Taylor Manifest Anxiety Scale.

Subjects: 183 college juniors and seniors.

Procedure: A questionnaire was administered consisting of two sections; (a) Randomized Taylor "manifest anxiety" scale items and M.M.P.I. K scale "defensiveness" items (b) Open-ended future time perspective questions designed to tap "plans for the future" and the "anticipation of major vague or specific goal achievement difficulties"; and randomized Likert-type items designed to tap "future fears", "pessimism", "feelings of helplessness", "aspiration level", "feelings of cognitive clarity", "flexibility-rigidity", and "future emphasis".

Respondents' plans for the future were rated for clarity by two judges. Scales were examined for internal consistency. A tetrachoric correlation matrix was calculated and cluster analyzed by a modified Tryon procedure.

Results: A cluster analysis of all variables reveals the presence of three clusters. Cluster X, labeled "exaggerated

goal frustration fears" contains the variables of "future fears", "anticipation of specific major goal achievement difficulties", "high aspirations" and "future emphasis".

Cluster Y, called "dismal unclarity" contains the variables of "low observer-rated clarity of plans", "feelings of lack of clarity", "unsatisfied needs for greater clarity", and "pessimism". These two future time perspective clusters are orthogonally related. Both are found significantly related to a third cluster labeled "anxiety" which contains the variables of "manifest anxiety", "anticipation of major vague goal achievement difficulties", and low "defensiveness".

The content of cluster X suggests a particularly self-defeating kind of displacement involving exaggerated fears for the realization of such highly emphasized life goals as graduating from college, finding a suitable job, getting married, etc. This constellation supports, in part, the cognitive future time perspective characteristics of the anxiety state postulated by MacKinnon. In his formulation the anxiety neurotic is said to emphasize the psychologically distant goal regions of the future time perspective dimensions which are simultaneously perceived in an unduly fearful and hopeful fashion.

Cluster Y is congruent with Goldstein's theory that anxiety interferes with the "abstract attitude", involving the ability to plan ahead. The self-defeating nature of the anxiety state is revealed in that the clarity of the psychological environment so desperately needed by the neurotic is frustrated by anxiety-induced interference with the higher organizational processes. The resulting cognitive vagueness seems to threaten further the already precarious security of the neurotic.

Conclusions: 1. The data resolve certain divergent formulations regarding the cognitive future time perspective characteristics of the anxiety state and reveal that anxiety shapes future time perspective in two distinctive self-defeating modes. 2. The validity of the widely employed Taylor Manifest Anxiety Scale is buttressed.

66 pages. $2.00. Mic 58-4849

PERSONALITY FACTORS IN ATTITUDE CHANGE

(L. C. Card No. Mic 58-953)

Charles Graham McClintock, Ph.D.
University of Michigan, 1957

The major question which this thesis attempts to answer is whether different kinds of influences, selected because of their assumed relevance to the operation of particular personality dynamics, can be successfully employed to produce attitude change. Basically two types of personality characteristics are considered: (1) ego-defensiveness, based upon the classic pattern of repressed hostility and its projection, and (2) other-directedness, or the basic tendency to conform to any and all social pressures. Three types of influence were designed to change attitudes toward the Negro: (1) a self-insight procedure utilizing a case study illustrating the developmental dynamics of prejudice; (2) an informational communication providing rationalizations for the maintenance of prejudicial attitudes towards Negroes.

The basic design of this study called for obtaining measures from subjects at three distinct times. At a first session, 252 subjects enrolled in the University of Michigan and Eastern Michigan College completed a set of personality measures and attitude scale. At a second session, one week later, 91 female subjects read the self-insight materials, 107 female subjects read the informational influence materials, and 54 male and female subjects read the ethnocentric communication. Immediately following the reading of the influence materials, all subjects were requested again to fill out the attitude scale. After a five week interval, the subjects again completed an attitude measure which was identical to that administered in the first two sessions.

The measures of personality, i.e., ego-defensiveness and other-directedness, consisted of two sub-scales from the California F Scale. The measure of attitude was based on a Likert-type scale which included fifteen negative Negro stereotypes. Our measure of attitude change was computed by assessing the direction of change by subjects from the first to last session.

For the informational communication it was found that there was a monotonically increasing relationship between the degree of other-directedness and change in the direction of the influence. That is, a greater proportion of persons who scored high on other-directedness moved in the direction of the influence than those who scored in the middle or low categories. Likewise the middles changed more than the lows.

For the self-insight procedure it was found that individuals who were moderately ego-defensive were more likely to change in the direction of the influence than were individuals who were either high or low in defensiveness. Moreover, as anticipated, the lows showed more change in the direction of the influence than the highs.

Finally, for the ethnocentric influence it was found that individuals high in ego-defensiveness or high in other-directedness tended to move in the direction of this influence more than individuals low in defensiveness or low in other-directedness. As anticipated, individuals low in defensiveness and individuals low in other-directedness tended to reject this influence and moved against it, i.e., became less prejudiced towards Negroes.

In conclusion, it appears that knowing the role that certain attitudes play in the personality structure of an individual is relevant to the theoretical understanding of the phenomena of attitude change, and to the devising of appropriate and effective techniques for changing attitudes.

116 pages. $2.00.

EXPERIMENTS ON THE THEORY OF BALANCE

(L. C. Card No. Mic 58-1436)

Julian Oliver Morrissette, Ph.D.
University of Michigan, 1957

Problem and Theory. This thesis reports a series of experiments concerning tendencies towards balance in the perception of interpersonal relations. Its purpose is to

evaluate certain refinements, proposed by Cartwright and Harary, of a theory originated by Heider.

The basic terms in Heider's theory are entity (person or object) and relation. He distinguishes Unit (U) relations, which express the binding together of entities in a system, and Attitude (A) relations, which express the affect existing between entities. Each relation may be either positive or negative (±). He defines 2- and 3-entity systems such that they are either balanced or imbalanced, according to the configuration of the relations existing in them.

Heider advances two hypotheses concerning the structure of interpersonal relations: I--If no balanced state exists, then forces toward this state will arise; II--If a balanced state is not attained, then the state of imbalance will produce tension.

Cartwright and Harary, using the mathematical theory of signed graphs (s-graphs), which deals rigorously with patterns of entities and relations generalize Heider's definition of balance so as to permit consideration of n-entity systems and refine the definition so as to deal with degree of balance of the whole system and with degree of balance at a particular point.

Employing these refinements, Heider's two hypotheses are restated as follows: I--The magnitude of forces toward balance is inversely related to the degree of balance of the system; II--The magnitude of tension created by a system is inversely related to the degree of balance of that system.

A series of experiments were designed to test the revised hypotheses for both 3- and 4-entity systems.

Method. A paper-pencil test form was used. Hypothetical social situations were described which manifested various U and A relations and which involved three or four persons, one of whom was the subject. Between some persons A relations were not given and the task of the subject was to predict what he thought they would be. The theory of balance holds that the subject will predict relations which will maximize the degree of balance of the system. After making this prediction the subject answered three questions which were designed to measure the tension he would experience in the predicted system.

Eight experiments were conducted, involving a total of approximately 700 subjects.

Results. It was found that in both 3-entity and 4-entity systems the s-graph definition of degree of balance at point p (the subject) ordered the data consistently with the revised hypotheses, provided that +U relations are assumed to exist among all pairs of entities. More specifically, the subjects predicted A relations which resulted in structures having the highest degree of balance more frequently than would be expected by chance, and the tension they reported decreased significantly (on two of the three tension items) as the degree of balance of the structure they predicted increased.

Since it was found necessary to assume +U relations, the question arose as to whether the theory would succeed if systems containing -U relations were experimentally established. The results obtained from several experiments indicated that we failed to induce -U relations. It was found, however, that the data were consistent with the two revised hypotheses provided we assume that in these experiments weak +U relations were established.

Conclusions. The consistency with which the refined and generalized statement of Heider's theory was supported suggests that expressing the theory of balance in the terms of s-graph theory provides an effective basis for dealing with important features of interpersonal relations.

179 pages. $2.35.

RATIONALITY IN THE DETERMINATION OF THE SOCIO-ECONOMIC ATTITUDES OF A DEMOGRAPHICALLY HOMOGENEOUS GROUP OF SEMI-SKILLED AND UNSKILLED MANUAL WORKERS

(L. C. Card No. Mic 58-978)

Otto Martin Riedl, Ph.D.
University of Michigan, 1957

This study was designed to test the role of "rationality" in the determination of the socio-economic attitudes of a group of semi-skilled and unskilled manual workers. The data to test the specific predictions were gathered in a four-hour interview survey of 449 workers in the Detroit area. Questions consisted both of open-ended and check-list items. The socio-economic attitudes under consideration included beliefs with respect to power and privilege of unions and of management, and with respect to social welfare legislation.

Rationality of socio-economic attitudes was defined in three ways:

1. Objective rationality - the association of liberal attitudes with low economic success, and the association of conservative attitudes with high economic success.
2. Affect-congruent rationality - the association of liberal attitudes with dissatisfaction, and the association of conservative attitudes with satisfaction.
3. Percept-congruent rationality - the association of liberal attitudes with advancement-dissatisfaction, or pessimism regarding one's own future prospects, and the association of conservative attitudes with advancement-satisfaction, or optimism regarding one's own future prospects.

It was found that socio-economic attitudes tended to be rational, as defined by each of the different types of rationality, but that these relationships, though significant, accounted for only a very small part of the total variance. It was only for those people in whom the three forms of rational considerations were working hand in hand that the relationships assumed any considerable strength.

The attempt to specify the conditions favoring rationality, and those depressing such rationality, proved unsuccessful. The relationships between objective success or failure and socio-economic attitudes; between satisfaction-dissatisfaction and socio-economic attitudes; and between advancement-satisfaction or advancement-dissatisfaction do not seem to be stronger for the more sophisticated and knowledgeable respondents. Nor were these relationships stronger for those whose satisfaction scores were "purified" by removing non-objective components of dissatisfaction, such as neuroticism, or by removing those components of satisfaction which are the result of attitudes of anomie, i.e., feelings of apathy and helplessness.

The variable with the highest degree of relationship to socio-economic attitudes found in this study was anomie. Anomic attitudes were measured by a five-item scale. These items appear to be tapping dimensions of apathy,

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futility, or cynicism. Those high in anomic attitudes tend to be more liberal, and those low in anomic attitudes tend to be more conservative.

A revised rationality model of socio-economic attitudes was then proposed. It was postulated that such attitudes tend to be determined at least as much, if not more, by irrational factors as by rational factors when the social and economic situation is one of abundance and increasing well-being. The inference would be that when a condition of economic scarcity exists and the objective success and satisfaction of large numbers of workers are reduced, then rational determinants of socio-economic attitudes will play a much larger role - the dissatisfied and unsuccessful having a stronger tendency to be liberal, the satisfied and successful a stronger tendency to be conservative. In the same vein, it was suggested that rationality factors will play a larger role in the determination of socio-economic attitudes when the populations considered are heterogeneous with respect to success and satisfaction, i.e., when comparing people of different class and occupation groups, than when the population considered is more homogeneous with respect to class and occupation. 175 pages. $2.30.

A PRELIMINARY STUDY OF SOCIAL PSYCHOLOGICAL FACTORS IN AMERICAN PSYCHOLOGICAL LEADERSHIP, 1892-1952

(Publication No. 25,462)

James Harry Ritter, Ph.D.
The Ohio State University, 1952

INTRODUCTION

A thorough perusal of the literature on leadership indicates that leadership is not a single-faceted trait which can be studied by any method in any situation.

Heretofore, armchair methods, methods of experimentation on children and goats for leadership traits applicable to adults, methods of measuring "general" leadership traits have been used. Little agreement between the results of such methods have been found.

To date there have been only incipient attempts to investigate the inter-operations of personality and social factors. Most investigators have accepted the clinicians' method of investigating or attempting to investigate the internal variables. The clinician and his brother psychologists are prone to deal with concepts such as motivation, intelligence, and perception, all concepts that despite being influenced by external events persist within the "black box" of the organism. Despite lip service to the contrary the clinicians still fail to give social factors their proper weight. In part this is due to the inability to quantify the variables. However, the inability to write these factors into the final equation of a life history is more nearly due to their inadequate conceptualism. The model for such thinking is not yet clear and quantification may be a long way in the future. Yet it is possible to analyze and to an extent quantify the interactions of various personalities having different backgrounds with various kinds of group atmospheres.

PROBLEM

The present study is predicated on the belief that leadership is not due to specific factors or traits alone nor necessarily to groups or families of attributes as such but that leadership is due to the pattern of traits evolving out of particular situations.

Leadership in the study is confined to one field of endeavor—psychology, in one country—the United States, between the years 1892 - 1952 and is defined operationally in terms of holders of psychological elective positions of eminence.

Leadership is believed to be a multi-dimensional phenomenon including interactions of cultural factors, sociological factors, personality factors, professional competence factors, and having to do with the structure of intimate groups and environment. The problem here is to determine the concomitant and determinant interrelations that contribute to leadership by the study of four aspects: 1. The familial and social background of American Psychological leaders from 1892 - 1952, 2. The atmosphere of the psychological groups where they received their doctorates, 3. The personalities of the most influential men, 4. The institutional structures of the universities where these men studied and taught.

REVIEW OF LITERATURE ON LEADERSHIP

The literature on leadership is vast. Unfortunately, relatively little of it is empirical. No study has duplicated the methods or tested the same populations or leaders that another study has, nor are definitions of given traits or even of leadership the same. Thus it is not surprising that a hodge-podge of results have accumulated. The scientific objective studies with comparable groups of leaders in particular situations tend to indicate that leadership is:

1. Situational but transferable to similar situations.
2. Trainable - if one knows what to train for and the material is normal or superior.
3. Concomitant with eminence or executive position.
4. Not all-or-none, but in degrees depending on the situation as well as on the person.
5. Characterized by many methods.
6. An interpersonal, intergroup, i.e., a social, phenomenon.

METHOD

In this study, leaders were operationally defined as:

1. American Psychological Association presidents
2. American Men of Science who were starred psychologists
3. National Academy of Science members who were psychologists
4. International Congress of Psychology officials
5. American Association for the Advancement of Science officials who were psychologists
6. American Association of Arts and Sciences members who were psychologists

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7. National Institute of Psychologists members
8. Howard Crosby Warren Medal recipients
9. American Association of Applied Psychologists officials
10. Society for the Psychological Study of Social Issues chairmen
11. Eastern Psychological Association presidents
12. Midwestern Psychological Association presidents
13. Western Psychological Association presidents
14. Society of Experimental Psychologists members
15. Southern Society for Philosophy and Psychology chairmen
16. American Psychological Association Division chairmen
17. Rocky Mountain Psychological Association presidents.

Oral interviews of the nearly two hundred individuals represented above was beyond the scope of the study because of the limits of time and money. The only feasible method was by use of questionnaire.

The questionnaire is composed of five sections: 1. Individual or personal factors, 2. Institutional factors, 3. Personal traits of influential men, 4. Group atmosphere factors, and 5. Group traits. It was revised and improved by five preliminary tryouts, the last three on a total of 40 psychologists at the Ph.D. level. It was sent to 160 living leaders and 100 non-leaders. A similar form, shortened in length, was sent to 20 close relatives of dead leaders.

Several assumptions have been made. (1.) There are "ideal" and "non-ideal" institutions for scholarly productivity, "ideal" and "non-ideal" being operationally defined in terms of questionnaire institutional factors 5, 6, 7, 8, 9, and 13, productivity being defined by questionnaire experience and publication factors 18, 19, 20, 21, 22, and 23. (2.) Election to an outstanding position (VGL) is more indicative of leadership ability than election to a lesser position (LTG). (3.) "Groups" or "schools" of psychology tend to be fostered by "ideal" institutions and lead to greater productivity.

A Chi-square technique was used to determine whether VGL have more than chance relations with "ideal" universities, productivity, and group atmosphere. If it does, it can be assumed that "ideal" universities were conducive to the eminence of these men - in some way or other - and that the "non-ideal" places actually thwarted the development of the men who had to operate in them.

Very great leaders (VGL) were operationally defined as: presidents of APA, members of NAS, being starred in AMS, holding an official position in the International Congress, members of AAA & S, presidents of AAAS and being awarded the HCW medal. They were further divided into living (LVG) and dead (DVG) categories. Less than very great leadership (LTG) constituted chairmanship of all other psychological organizations. Non-leaders (NL) were defined as any psychologists who had not been president or chairman of one of the above mentioned psychological organizations, had not been a member of NAS or AAA & S, had not been starred in AMS or awarded the HCW medal.

RESULTS

1. Leaders were found to differ from non-leaders in father's age at time of individual's birth, mother's age at time of individual's birth, father's occupation, relative position in the family, marriage age, socio-economic status of the family, and lineal descent.
2. The LTG leaders were more like the non-leaders than the LVG or DVG leaders on number of children in family, age of having first child, number of children individual has, and birthdates.
3. There were no differences discernible for birthplace, father's name, mother's name, father's education, mother's education, and father's residence, and very slight differences for outstanding relatives.
4. NL's taught at more colleges than leaders. LVG and DVG leaders taught more at the nine colleges which produced the bulk of the leaders. There were a few colleges where no LVG or DVG, and few or no LTG, leaders taught; teaching was done predominantly by non-leaders.
5. NL's had more professional experience entries. More LVG's and LTG's served as government consultants; more LTG's served as private business consultants; more LTG's and NL's served as hospital clinicians.
6. Most LVG's taught 2-6 hours per week. Most NL's taught 7-14 hours per week. Half the LTG's taught 2-6, half, 7-14 hours per week.
7. LVG's recommended most outstanding students and recommended more from nine colleges which produced the bulk of the leaders. LTG's recommended fewer students and recommended them from more colleges. NL's recommended very few students, almost none from the nine colleges, and students recommended were from Ph.D. universities not recognized by the leaders.
8. LVG's supervised most Ph.D.'s; LTG's, less; and NL's, very few.
9. DVG's established most original journals, laboratories, societies and businesses. LVG's re-established, reorganized, and revised most, the LTG's, less, and the NL's least. LVG's re-established most laboratories whereas LTG's established or re-established most clinical and minor governmental psychological services.
10. LVG's published most books and other publications, had most books reprinted, had most books widely adopted, and had highest reprint demand. In general what evidence is present places DVG's in same category. LTG's had less, NL's, fewest.
11. Leaders invented more equipment, devices and tests than non-leaders. LVG's constructed more equipment and devices; LTG's, more paper and pencil tests.
12. When questionnaire items 18, 19, 20, 21, 22, and 23 are combined to make a productivity score, the LVG's are superior to the LTG's, who in turn are superior to the NL's.
13. LVG's favored animal and behavioristic psychology; LTG's favored psychophysical and education; NL's favored clinical and social.
14. Background features considered important by the leaders were good educational opportunities and training. NL's favored cultural opportunities and colleagues. LTG's indicated contact with a great leader.
15. Handicaps of career listed by LVG's were poverty, health, and personality factors, LTG's thought they were

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inhibited by their teachers. NL's believed poverty and marriage factors held them back.

16. Most leaders came from 9 U.S. Ph.D. schools: Chicago, Clark, Columbia, Cornell, Harvard, Hopkins, Iowa, Stanford, and Yale. Few NL's came from these schools. Eight of these schools are private; six are located in the northeastern section of the U.S.

17. Most Ph.D. schools are located in the northeastern section of the U.S.; next highest come from the north central section; fewest, from southern sections.

18. LVG Ph.D. dissertations were oriented toward animal-behavioristic-physiological psychology; DVG, toward physiological; and NL, toward social psychology.

19. Most leaders had their dissertations supervised by leaders; few NL's had dissertations supervised by leaders. LVG's and DVG's selected different leaders to supervise Ph.D.'s from the LTG's supervisors.

20. More days per week and hours per day were spent as graduate students on research by the leaders than the NL's and more by the great leaders (LBG and DVG) than the LTG's.

21. Most LVG's rated their school among the top 2; few LTG's gave their school this rating; and very few NL's so rated their Ph.D. school.

22. More NL's and LTG's than LVG's indicated they could not work in university buildings as late as they wished.

23. Both leader groups (LTG and LVG) indicated greater tendencies for their faculties to spend more time (1/4 & 1/2 plus) working after hours than did the NL group.

24. Nearly 50 per cent of all outstanding faculty leaders listed belong to our leader group. Of the 31 leaders mentioned 5 or more times, all belong in our category of very great leaders (LVG or DVG). LVG and LTG show definite differences in faculty leader selection. NL's agree with LTG's.

25. LVG's came from small graduate psychology departments; LTG's, from medium sized; NL's showed a tendency to come from the largest.

26. LVG's used other university laboratories 50 per cent of the time and facilities in nearby cities 14 per cent of the time when they were not using the psychology departments. NL's showed similar results. LTG's indicated they used more available facilities.

27. A composite "ideal" or "liberal" score was obtained by combining institutional items 4, 5, 6, 7, 8, and 9. The average liberalness factor for the LVG group was higher than that for the LTG group which in turn was higher than that for the NL's.

28. Leaders consistently rated those who influenced them higher than non-leaders on all items; LVG's rated higher on all three choices than LTG's.

29. Leaders tended to be influenced mostly by leaders; non-leaders were influenced less by leaders. LTG leaders are influenced by different leaders from those who influenced LVG leaders.

30. Men who influenced leaders "always" or "frequently" exhibited the 34 traits indicated; men who influenced the non-leaders showed these traits somewhat less frequently.

31. Of the 35 names given under group name, 37, under group founder and 41, under leader at time of membership, 75 per cent fall in our leader category and 20 per cent are "other leaders." Of the 5 individuals mentioned more than once under group name, 8, under founder, and 23, under outstanding staff members, all of the first two groups and 19 of the 23 of the last belong to our leader classification. The LTG's and NL's mentioned more names for outstanding staff members than did the LVG's.

32. Most group foundings took place during the periods of 1910-1915 and 1920-1935.

33. Most groups were composed of 2-5 staff and student members. Only LTG groups had 11-20 members. Six of the 14 students mentioned more than once as belonging to a group are in our leader category.

34. Most LVG groups met irregularly, LTG's, once a week, NL's, twice a week.

35. Behaviorism was most often mentioned by all as the dominant philosophy. Nearly all categories indicated no changes took place in the philosophy while they were members. What changes took place were toward behaviorism, Gestalt, mental testing, and different philosophical emphasis.

36 Nearly all leaders and non-leaders were interested in the field of experiemntal psychology. LTG's were next interested in behaviorism; NL's were next interested in clinical psychology and behaviorism.

37. Group research problems were: animal, introspection, and learning for the LVG's, learning and perception for the LTG's, learning and social for the NL's.

38. The number of Ph.D.'s given to groups members were: LVG's, 3; LTG's, 4; NL's, 2.

39. Most group financing was by the psychology department, next, by private means.

40. LVG's had most similar groups at other colleges, LTG's, next, NL's, least, but most individuals in all three categories indicated no such duplicates.

41. LVG's thought influence of group in attracting graduate students was "nil;" LVG's thought it was "quite" influential; and NL's split between "quite", "moderately," and "not at all."

42. LTG's listed group traits highest (frequently), NL's next (frequently) and LVG's lowest (occasionally to frequently).

CHI-SQUARE ANALYSIS

After the results in the previous section has been tabulated they were analyzed by using Chi square according to productivity – no productivity; group – no group atmosphere; LVG, DVG, LTG, NL (i.e. leadership – no leadership); dates of Ph.D.; Ph.D. from the nine institutions which produced the bulk of the leaders – all other institutions; section of country where Ph.D. college was located, and ideal (liberalness) – non-ideal (nonliberal) factors.

College-Non College (Nine institutions which produced bulk of leaders-all others)

There was no significant interaction among the nine colleges and productivity, leadership, and date of receiving Ph.D. degree. There is a difference between these colleges regarding belonging to a group.

There was a significant difference between these nine colleges and other U.S. colleges regarding leadership, productivity, ideal (liberalness), private or public, and section of country where located.

Section of United States College Location

There was a significant difference between receipt of a Ph.D. from a college in the East, Central, and Western

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portions of the U.S. and ideal, college - non-college (see above) and group belongingness.

Private or Public University

There was a significant difference between whether the Ph.D. university was private or public and factors of idealness (liberalness), college (nine leading institutions), group belongingness, leadership, section of the country where located, and date of Ph.D. degree.

Leadership

Leadership shows significant interactions with idealness, college (nine leading institutions), private university, and productivity.

Ideal (liberalness)

Liberalness is significantly related to leadership, private institutions, college (nine leading institutions), and productivity.

Productivity

Productivity was significantly related to college (nine leading institutions), leadership, and idealness.

Group Atmosphere

Group belongingness while a graduate student was significantly related to the location of the Ph.D. university, its idealness, and its being private.

Date of Receiving Ph.D.

Date of receiving Ph.D was significantly related to private-public aspects of universities.

SUMMARY OF THE RESULTS

1. Leaders are significantly different from non-leaders in productivity (of students, writings, and equipment), liberalness, ratings of those who influenced them, being influenced by leaders, time spent on research as graduate students, and teaching at those universities which produced the bulk of the leaders.

2. If leaders are divided into living very great leaders (LVG), dead very great leaders (DVG) and living less than very great leaders (LTG), it is noted that the living and dead great leaders resemble each other very closely. In general, they are superior to the others on productivity, liberalness, ratings of leaders, etc. The less than very great leaders showed distinctly lower ratings on nearly all these items; they seemed to place between the great leaders and the non-leaders.

3. Certain universities have produced the bulk of the psychological leaders. These universities are significantly different from others in factors of liberalness, being private institutions, sectional location in the U.S., and productivity.

DISCUSSION AND RECOMMENDATION

The results indicate a pattern of psychological leadership.

Living great leaders teach less per week. Perhaps this is a factor in their being great leaders, i.e., if capable men are given freedom from excessive teaching loads they produce work which elevates them to elective leader positions.

Great leaders not only come from but teach at leader producing schools. This suggests that leaders attract potential leaders and that good graduate students are encouraged to produce work which gets further recognition for the leader and perhaps makes the student eventually a leader.

Great leaders tend to produce more. Apparently these leaders carried over their graduate student work habits into later life. Apparently one factor in psychological leadership is working longer hours, doing more research work, and, as graduate students, having advisers who do more work.

In order to do more work, one must have the facilities. It is significant that more great leaders were able to work late in university buildings and have either psychological or other laboratories available when needed for such work.

As graduate students, apparently it is important for great leaders to be allowed a permissive, liberal atmosphere in which to develop. Otherwise, ideas, work habits, and professional growth may be stunted.

Leaders tend to be influenced most by leaders. Non-leaders are influenced less by leaders. Apparently, leaders recognize and take advantage of personal influences and opportunities offered. Perhaps this is what eventually enables them to become leaders.

There is a difference between public and private institutions in the production of leaders. Private institutions are less prone to public pressures and have more permissive freedom. Perhaps such permissive freedom is necessary for the development of leaders.

313 pages. $4.05. Mic 58-4850

Abstract published by special arrangement with The Ohio State University.

A PROPOSAL FOR A CLASSIFICATION AND TYPOLOGY USEFUL IN UNDERSTANDING HUMAN RELATIONS TECHNOLOGY: AN EXPLORATORY STUDY

(L. C. Card No. Mic 58-669)

Mary A. Wiederhold, Ph.D.
New York University, 1957

This study with a prime focus on destructive social conflict deals with a proposed classification and typology which, it is hoped, may be useful in understanding human relations technology. Chapter I introduces the problem, gives its delimitations, definitions, assumptions, hypotheses, and sub-problems.

Chapter II outlines the salient significance of the study: (1) for science in general, (2) in terms of its implications as a framework for the unification of science, (3) in terms of its implications for human relations, and (4) in terms of its implications for social control of destructive conflict. In the approaches to these problems, Field-theoretical and Gestalt formulations are applied.

Chapter III treats the related studies in three subdivisions: (1) General approaches to the problems of outlining a typology as proposed in this study. (2) Literature which deals with psychosomatic and/or psychic destructive

conflict. (3) Studies which bear on social conflict on the national and international levels.

Chapter IV develops an original method for the establishment of classifications in detail on the basis of which an a posteriori analysis is undertaken. This analysis deals with an example of destructive conflict on the simplest level concerned in this study, specifically, human malaria. An attack based on one similar to that operative in general medicine is undertaken on the assumption that medical science made its most striking advances from the time when it began to concern itself with the etiology of diseases. The a posteriori analysis yields five classificatory orders which appear to operate in the causation of disease; moreover, it provides the basis for the emergence of three levels in terms of increasing complexity of causal forces operating in destructive conflict; and, finally, it yields the schematic paradigm for the construction of categories to which criteria drawn from the human sciences are applied.

The five classificatory orders of causal forces abstracted through the inductive analysis are: (1) the Clinical, (2) the Gross, (3) the Cosmic, (4) the Microscopic, and, (5) the Submicroscopic. The three salient levals elaborated in terms of increasing range of complexity of causal forces operating are: (1) General Medicine; (2) Psychosomatic Medicine and Psychiatry; (3) Psychosocial Medicine on two levels: (a) national, (b) international.

Chapter V presents the elaboration of the a priori analysis which is focussed on destructive conflict as it may occur in examples of Psychosomatic Medicine and Psychiatry in order to discover whether the five classificatory orders operate therein.

Chapter VI addresses itself similarly to the deductive analysis of an example of destructive social conflict which may occur within a nation. The example elaborated is that of the riots between white and Negro citizens which occurred in Detroit, Michigan, in the spring of 1943.

Chapter VII presents a similar elaboration of the final step in the paradigmatic scheme, by means of an a priori analysis of an example of destructive conflict on the international level. The specific example is that of the Arab-Israeli conflict as it developed in its salient aspects during the period 1954-1956.

Chapter VIII presents a summary, conclusions and recommendations. Moreover, suggestions for a coordinated attack on destructive social conflict are elaborated; approaches based on theoretical, empirical as well as experimental knowledge are recommended. Finally, the crucial need for an Institute for Conflict Analysis is underscored. 434 pages. $5.55.

SOCIOLOGY

SOCIOLOGY, GENERAL

THE AGE OF WOMEN AT COMPLETION OF CHILDBEARING: DEMOGRAPHIC FACTORS AND POSSIBLE SOCIAL CONSEQUENCES: UNITED STATES, 1910-1950. A DEMOGRAPHIC STUDY.

(L. C. Card No. Mic 58-1336)

Lincoln H. Day, Ph.D.
Columbia University, 1957

The purpose of this study was, first, to determine whether any changes have occurred since 1910 in the ages at which women in the United States complete their childbearing and, second, to describe whatever changes were found to have occurred, assess the demographic factors involved, and suggest the implications of these changes for other aspects of social life. A review of the literature showed that little research had been done in this field and that what had been done was subject to several limitations, in particular, the paucity of socio-economic differentiation and the failure to consider differences between age cohorts.

The basic materials were derived from the Censuses of 1910, 1940, and 1950. To make use of these data -- date in which mothers are subdivided by whether they have children under 5 years old -- all mothers who had not borne an additional child for a period of at least five years were defined as of completed childbearing. The validity of this assumption was checked by the use of certain non-Census data.

Further use of these non-Census data revealed a tendency to postpone childbearing for periods in excess of five years in response to depression conditions of the 1930's. Because the 1940 Census data reflect this postponement, the important comparisons were those which were to be made between 1910 and 1950, rather than between either of those dates and 1940.

Before computing the proportion of "completed" childbearing the Census data were adjusted for (1) underenumeration and (2) infant and child mortality.

The basic findings were two: (1) There have been changes since 1910 in the ages at which women complete their childbearing; (2) These changes have been in the direction of an earlier average age at completion of childbearing and a greater concentration of childbearing in certain ages.

The timing and duration of childbearing can be affected through the mediary of only four demographic variables: (1) average family size; (2) age at birth of first child; (3) lapse of time between successive births; (4) number and duration of interruptions of the marriage pattern during the childbearing ages. Partially offset by opposite changes in variables (3) and (4), declines in average family size and in age at birth of first child were so extensive as to result in a secular increase between 1910 and 1950 of 8 to 58 percent in the various proportions of completed fertility above age 29, the greater increases coming at the younger ages.

Substantial differences between Negroes and whites were found at each period, proportional changes since 1910 being similar for each color grouping. A higher proportion of Negro women completed their childbearing below age

35 while, at the same time, a higher proportion continued to bear children in the later years of the fecund period.

The dominant changes by rural-urban residence were toward less diversity between the Census' three residential groupings in the proportion at any age who had completed their childbearing. Although changes occurred among mothers in each classification, those among rural dwellers were more extensive.

Subdividing by education, it was found that, in general, the greater the amount of schooling, the fewer the number of years devoted to childbearing.

Viewed in terms of the proportion of women freed for activities removed from childbearing and childrearing, changes as extensive as those found could have considerable influence on the social system. In discussing certain possible consequences of these changes consideration was given to the likelihood of an increase in the labor force participation of women and, then – largely in terms of whether labor force participation was first affected – to the influences these changes might have on stratification, social and cultural change, socio-economic planning, the economy, and the family. 200 pages. $2.60.

AN HYPOTHESIS FOR THE STUDY OF SOCIAL CLASSES IN AMERICA

(Publication No. 25,446)

Stanley Arthur Hetzler, Ph.D.
The Ohio State University, 1952

This paper is an examination of social position in relation to social stratification. It poses the question whether American society consists of a few fairly discernable social strata or of a multitude of highly overlapping individual social positions.

Several attempts have been made to construct a method whereby persons could be placed functionally within the social structure. A major limitation of all these studies is the initial procedure they employ. The investigators generally attempt to derive a picture of the community's class structure through careful observation or hearsay. Having once "determined" the number of classes within the community, the next step is to place the community members within their proper classes. It is obvious, however, that the general results have been predetermined by the investigator. The lack of agreement between the results of these works is striking. The Useems and Tangent found three distinct social classes, Centers found four, Hollingshead found five and Warner found six.[1] This study avoided any mention of a specific number of classes and used social position as an indirect approach to social class.

The research instrument employed was a simple profile scale which was exactly one foot in length. To reduce bias, it was given only two indices, one at either end. For scoring purposes the scale was divided into twelve inches, each inch representing a separate category.

Two university classes were used as subjects to pretest the reliability of the social position scale. The conditions under which it was administered were only partially controlled in one class, but in the other they were controlled as rigidly as possible. The coefficients of correlation between the test and retest for the two groups were respectively .64 and .91. This was sufficiently encouraging to warrant the further development and use of the instrument in a full scale community study.

The community chosen for the study was Washington Court House, Ohio. The universe sampled consisted of all the voting-age white adults within the city and its environs. A random sample was taken which consisted of the responses of three hundred people. An equal number of responses were obtained from each sex.

Using the community as a frame of reference, the respondents were asked to rate themselves on the following scales: 1. Dwelling Unit; 2. Family Wealth; 3. Personal Influence; 4. Family Background; 5. Occupational satisfaction; 6. Personal Income; 7. Social Position; 8. Social Position in the United States; 9. Estimated Social Position in 1940; 10. Occupational Prestige; 11. Social Class. A second series of scales was inserted to act as a measure of community attitude. They were: 1. General Town Satisfaction; 2. Working Conditions; 3. Job Opportunities; 4. General Economic Opportunities; 5. Social Opportunities; 6. Industries; 7. Schools; 8. City Government; 9. Churches; 10. Adequacy of Town Housing; 11. Recreational Opportunities; 12. Feeling toward Neighborhood People; 13. Residential Areas (quality of neighborhood housing).

The social position scale was used as an indirect measure of social class structure. When the results obtained upon this scale were plotted graphically, two cutting points appeared, indicating the possible existence of three major groups or classes. When the data were resolved into responses by sex and replotted, this cleavage still characterized the female responses, but in the male responses it was shifted and modified. The coefficients of correlation between social position and other scale and personal background criteria was low.

A graphic representation of the results obtained from the total N on the social class scale was also tri-modal. But when the responses were replotted in terms of sex,

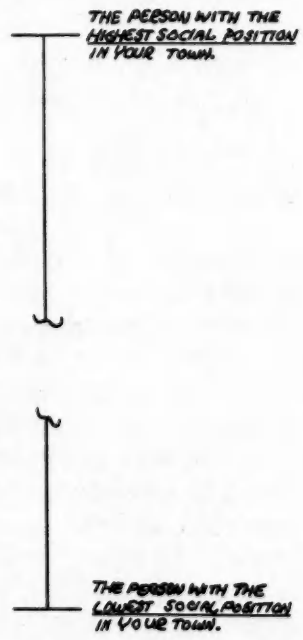


Fig. 1.–On the upper left-hand corner of the page the following instructions accompany the scale: On this scale rate what you think your social position is in your town. By social position we mean all the things that in your own opinion go to make up a person's social position within his community. Bear in mind that your social position is how YOU see yourself in your community. Study this scale very carefully and mark it as accurately as you can.

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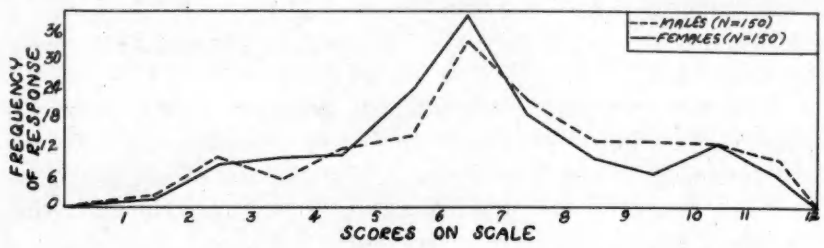


Fig. 2.–Distribution of Scores on Social Scale by Sex.

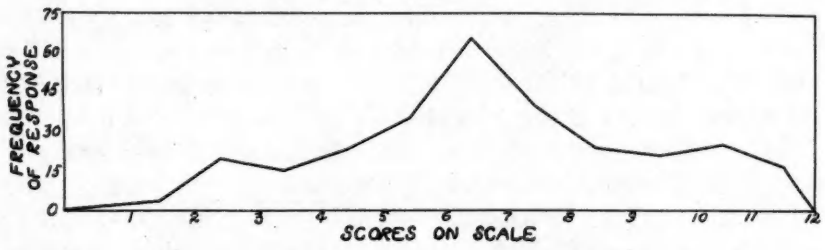


Fig. 3.–Distribution of Scores of Total Group (N=300) on Social Class Scale.

the structure was again changed. The responses of each sex were grouped in two modes. The male responses were structured only in the upper range of the scale and the female only in the lower. Since there was no apparent rationale for this shift in structuring, it was concluded that the tri-modality revealed by the total N was probably due to chance variation.

The coefficients of correlation between the social class scale and the other scales and personal background criteria were substantially higher than they were for social position. Thus a direct approach to the class problem would have been more profitable, but since the importance of this scale had been over-looked, it was not used in checking validity. The social position scale showed closer relatedness to such individualistic attributes as personal income and influence than the social class scale did. This may indicate that social position is regarded as being more of an individual power sphere, whereas social class pertains to attributes which give the person group affiliation.

Two methods of checking scale reliability were employed – the matched responses of husband and wife, and the test-retest. The matched responses of spouses on the social position scale yielded a coefficient of correlation of .40. The coefficient between the test and retest on the same scale was .81. The latter method indicated that the variables under consideration were fairly stable; hence, there must be a considerable difference between the perspectives of husbands and wives.

In order to determine the validity of the study, five carefully selected judges were asked to rate the social positions of thirty-five of the respondents whom they knew in common. The coefficient between the ratings of the median judges and the respondents was .48. However, the same degree of accuracy was attained by the investigators who, after a brief and casual interview, rated the respondent's social position on a separate six-point scale. This creates some doubt as to the efficacy of establishing validity through a panel of judges.

On one scale the respondents were asked to make an estimate of their social position for the year of 1940. These responses were then compared to the ones on the present social position scale. Although this did not measure actual mobility in the manner that Sorokin prescribed,[2] it at least registered "felt" mobility. The group as a whole felt that it had made a very slight gain in status since

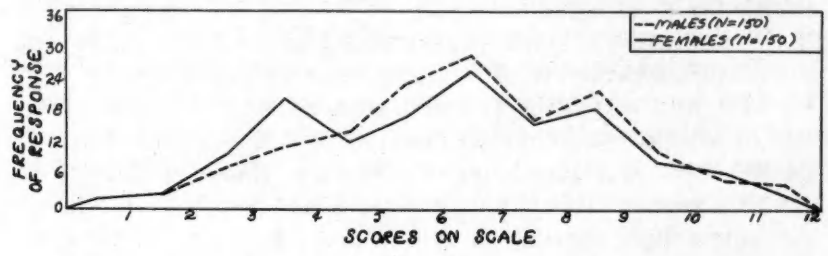


Fig. 4.–Distribution of Scores on Social Position Scale by Sex.

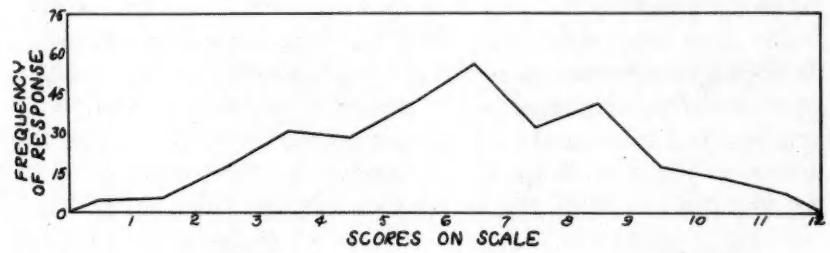


Fig. 5.–Distribution of Scores of Total Group (N=300) on Social Position Scale.

1940. Those with the least amount of education felt that they had regressed the most and college graduates registered the greatest amount of felt progress. The only occupational group which felt that it had substantially improved its status was the employee-supervisors. These people had presumably advanced from the laboring ranks.

A comparison of the occupational and educational status of the respondents with the occupational status of the father revealed an almost equal amount of upward and downward mobility. The occupational and educational transition between generations, however, was generally limited and gradual.

To test the consistency of status evaluation, the respondents were asked to rate their social position within the United States as a whole on one scale. When the group frame of reference was shifted, 52 per cent of the respondents felt that their status was lower in the larger society than it was in the community. Thirty per cent felt that their status remained constant, and 18 per cent felt that it had improved. Occupationally, only the executives felt that their status was higher in the larger society.

In relation to perspectives by sex, the males were more likely to rate themselves at either extreme of those scales pertaining to the self. The females were the conservative "middle of the roaders." In evaluations involving external estimates of a factual nature or neighborhood loyalties, there was close agreement between the sexes.

An attempt was made to determine the degree of radicalism or conservatism within different groups as reflected by the attitudes these groups held in regard to their occupational satisfaction, city government, industries, general economic opportunities and town satisfaction. By using the center point of the scale as the zero point of intensity, it was possible to determine not only the general attitude, but the degree of intensity with which that attitude was held. Different social and occupational groups did hold different attitudes toward the politico-economic aspects of the city. The lower strata of both sub-groups were critical (radical) and the upper groups were favorable (conservative). However, contrary to Centers' findings,[3] the total range in difference of opinion was not great. In rating the satisfaction-dissatisfaction they derived from their jobs, all occupational categories registered satisfaction, but the relative degree of satisfaction was consistently correlated with the status of the occupation. In regard to general

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satisfaction with the town, all of the various subgroups again registered positive satisfaction, but the degree of satisfaction varied with the subgroup's status.

This study revealed no demonstrable class lines in the city of Washington Court House, Ohio. If similar future studies should locate lines of cleavage, these certainly will not be severe. The psychological characteristics of various subgroups, insofar as they were investigated, did not stand in radical opposition to one another, nor was the total range of differences very large. This in no way implies that there are not enormous material differences between peoples at the opposite extremes of the social structure. However, the psychological void found in many European countries is here largely spanned by the still operative American creed of democracy and equal opportunity. But even more important to social contiguity is the absence of many of the European types of external insignia by which a person's status may be readily identified. Thus, beyond a certain sphere of intimacy, individuals simply cannot place one another quickly or accurately.

Admittedly, the instrument is rudimentary in character, but it has the following advantages. It avoids structuring the response but it still limits the number of variables being dealt with, thus eliminating much of the incumbrance and free translation of the ex post facto method. And finally, as an attitude scale, it combines the response with the intensity of the response in a single score.

293 pages. $3.80. Mic 58-4851

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Abstract published by special arrangement with The Ohio State University.

VALUES IN CRISIS SITUATION

(L. C. Card No. Mic 58-1342)

Alicja Iwanska, Ph.D.
Columbia University, 1957

The objective of this study was inquiry into mechanisms of the persistance and modification of values characteristic of the members of one social class, that of the pre-war Polish intelligentsia in two different crisis situations: extended imprisonment in Nazi concentration camps and subsequent exile in the United States of America.

Depth interviewing, retrospective in regard to concentration camp experiences and introspective in regard to the experiences in the U. S. A., was used as the main research technique in this study.

Five case histories of Polish inteligents dealing with their lives in concentration camps and in the U. S. A. were selected out of a larger group for a detailed analysis and presentation.

The description of the social, economic and cultural characteristics of the pre-war Polish intelligentsia class is presented in the Introduction. Special attention is given to their class values as seen against the background of the middle classes in other countries.

Chapters One and Two deal with the analysis of the two respective crisis situations: Nazi concentration camps and exile in the U. S. A., and an attempt is made to single out the elements of these situations which were experienced by Polish inteligents as most detrimental to their class values and their morale.

The subsequent five chapters contain a detailed analysis of the responses of five Polish inteligents to the two respective crisis situations. Five occupations characteristic of the pre-war Polish intelligentsia – teacher, lawyer, actor, priest and student – are represented among the individuals selected for this analysis.

The last, concluding chapter is devoted to the analysis of the persistance and modification of class values of the described Polish inteligents in concentration camps and in exile in the U. S. A. In this chapter it is shown that the same five Polish inteligents who were able to preserve their key class values and even partially reconstruct their cherished social institutions while in concentration camps, were unable to preserve their key values and find a satisfactory adjustment to life under the incomparably easier circumstances of their life in the U. S. A. These apparently paradoxical consequences are partially explained in this study by the sharp differences in social structure characteristic respectively of concentration camps and of the milieu of Polish exiles in the U. S. A. 221 pages. $2.90.

SOCIOLOGY, FAMILY

FERTILITY LEVELS AND DIFFERENTIALS IN TWO BENGALI VILLAGES

(L. C. Card No. Mic 58-875)

John Shields Aird, Ph.D.
University of Michigan, 1957

This study is an attempt to test the validity of several limited-range theories relating human fertility to social structure in agrarian society against data from two villages in East Pakistan. A complete census was taken in interviews with the heads of the 667 households in two Muslim villages on the outskirts of the city of Dacca. Some ethnographic materials and a discussion of the validity of the data are included as background.

The level of village fertility is discussed first in connection with Lorimer's hypothetical model of fecundity. Fertility rates are then presented by family structure variables: age of woman at marriage, age at birth of first child, interval between marriage and first childbirth, and widowhood and divorce, age difference between husband wife, polygynous marriage, order among husband's wives, joint family status, number of adults in household, crowding of accommodations, and sex of first-born child. Finally, rates are given by other socio-economic variables: occupation, size of landholding, size of rice crop, income,

wealth, literacy, migrant status, and distance from the city.

Fertility differences between social and economic categories are determined by comparing the rate of childbearing per woman per year of unbroken married life between the ages of 12 and 45 with that which would be expected if the same women had borne children at the average exposure specific rates obtained for the whole population. Statistical significance is indicated by the use of the Ratio Variance.

Fertility levels in these villages are high even for agrarian societies. Total maternity ratios for women ever married and for women continuously married are 7.01 and 8.15, respectively. Contrary to expectations, early age at marriage is associated with high fertility rates. Polygynous marriage does not seem to affect fertility rates nor does joint family status. Divorce and widowhood may reduce total maternity by about 10%. Income and wealth are directly related to fertility, and show the highest relationship of any of the variables studied. Most other socio-economic variables appear to draw their significance from their relation to these two.

Instead of the stable birth rates predicted for the beginning of the demographic transition, these data show a slight rise with urbanization. Malthus expected that economically depressed populations would restrict their own rates of reproduction through delay of marriage and thus escape the consequences of excessive population growth; however only in extreme cases does poverty delay the marriage of Bengali women, though there are indications that poverty may directly affect fertility through impairments to health. There is no convincing evidence that population growth in Bengal has yet outrun the means of subsistence. Neither social structure nor fertility is as unvarying in these villages as is sometimes claimed, nor is fertility close to the level of fecundity. It is usually supposed that extensive kinship relations in agrarian societies are a principal source of support for high fertility, yet Bengali joint families do not appear to lead to higher than average fertility. The idea that elaborate family structures may affect fertility through their greater power to enforce the prevailing social values is also unsupported. The thesis that the more remote aspects of social structure may influence fertility only through their effect on "intervening variables" is contradicted by the Bengali data. Causal "short-circuits" occur, whereby apparently remote factors bear directly on fertility.

While explanations of the general level of fertility in agrarian society seem reasonably successful, differential fertility does not seem to respond to major social and economic factors in agrarian life. It is suggested that this variation may be due primarily to physiological factors not related systematically to sociological variables. If so, sociologists may have to content themselves with accounting for general levels, leaving differentials largely to other disciplines. 363 pages. $4.65.

SOCIALISM, COMMUNISM, ANARCHISM

SOCIOLOGICAL AND PSYCHOLOGICAL PROBLEMS OF ECONOMIC PLANNING IN NORWAY

(L. C. Card No. Mic 58-1331)

Allen H. Barton, Ph.D.
Columbia University, 1957

In modern times the idea of economic planning has had three main sources. Marxian socialism wanted to replace the "anarchic" market system with "one single vast plan" once all capital was socially owned. Social reformers have wanted the government to act against depressions and extremes of inequality. Wartime governments have tried to control the economy to increase military output. The term "economic planning" is thus used for a variety of systems of government economic intervention. Both Stalinist Marxists and extreme conservatives have argued that the choice was between "total central planning" and complete laissez-faire, with no intermediate forms being workable.

Post-war Norway represented one such intermediate form. The economy was suffering from severe wartime losses and a flood of war-created currency. The Labor government rejected the "orthodox" policy of eliminating the excess purchasing power and allowing the market to deal with the situation, as followed in Belgium and West Germany. Imports, investments, prices, and allocation of essential consumer goods were controlled directly by government agencies, guided by a "National Economic Budget" made up for the year ahead. Government leaders felt that only by these means could they achieve their goals of a high rate of investment, the maintenance of full employment and the supply of necessary consumer goods to all according to need.

Various aspects of this system were studied by the Planning Project of the Sociology Department at the University of Oslo. This report includes empirical data from two studies: interviews with planning officials on the administrative problems of the detailed control of investment, and a nation-wide survey of the political response to the planning system as a whole at the time of the 1949 elections.

The Industry Directorate approved or disapproved investment proposals originated by industrial firms, within a total quota and priority rules set by the top planners. The priorities aimed largely at offsetting the inflated home-market demand by favoring export and producers-goods industries, and in the consumer area at favoring necessities over luxuries. A major problem was to see that these priorities were applied with equal rigor by all individual licensing officials for all industries.

Planning officials generally agreed that the system was effective in keeping the allotment of resources within the totals set by the Economic Budget, and in maintaining general adherence to the priorities. Detailed decisions in many cases however, were felt by the decision-makers themselves to be difficult and crude. None of the industry investment licensing officials felt that the system was more than an emergency measure, although some thought a more limited control based on much more research might be useful in normal times.

The 1949 elections returned the Labor government to power. The election survey showed that over one-third of

the Labor voters came from the white-collar and farmer groups. These non-working-class groups seemed to be attracted to the Labor party especially by its emphasis on stable prices and fair distribution of necessities, along with a general feeling that the economy was progressing. Most people, however, had only a partial and vague notion of the economy as a total system or of the government's economic planning policies. Occupational groups lined up differently on different specific questions of economic policy, suggesting that modern techniques of economic intervention create interests cutting across traditional class lines.

The Norwegian experience suggests that detailed central planning of important parts of the economy can be used in an emergency where the market system might not work well, and work in a way acceptable to the public; but that present techniques at least are rather crude and do not offer a permanent substitute for the market outside of rather drastic emergencies.

617 pages. $7.85.

SPEECH — THEATER

STUDIES IN THE RHETORIC OF WILLIAM EWART GLADSTONE

(L. C. Card No. Mic 58-607)

Albert Angus Austen, Ph.D.
Cornell University, 1957

The long and distinguished public life of William Ewart Gladstone was closely related to his career as a speaker. It is, therefore, the purpose of these five critical studies, through an examination of a representative cross section of his speeches in Parliament and on the hustings, to determine the characteristic features of his rhetoric.

The conflict between Disraeli and Gladstone over the former's budget of December, 1852 and Gladstone's own first budget speech of 1853, to which it led, are analyzed in detail, with regard especially to the immediate political situation and to the relation between the formulation and exposition of policy in the House. Gladstone's success in this struggle is shown to have resulted from his making firmer policy decisions on many points, from the availability of more complete financial data, and from his talent for patient and orderly but enthusiastic presentation of detailed financial reasoning.

The Midlothian campaigns of 1879 and 1880 are reviewed as illustrative of Gladstone's practical command of many of the techniques which have become common in national political campaigns. His short "railway" speeches and his longer, more formal addresses are studied for selection of topics, structure, tone and style and these are brought into relation with the principal purposes of the campaigns.

Gladstone's work on the floor of Commons in the relatively uneventful year of 1872 is surveyed to provide a view of his mature parliamentary style in routine situations. This view is then contrasted with his speaking in a moment of crisis through a detailed inspection of the speech in which he introduced his first Home Rule bill in 1886.

Gladstone's well-known habit of elaboration is defined and illustrated from recorded speeches and its causes attributed principally to a high degree of mental activity coupled with a lack of imagination and of the artist's controlled power of selection and statement of ideas.

From contemporary comment his delivery is shown to have developed over a period of years from a subdued, scholarly style to one of great energy and force. A full explanation of the change, however, has not been found. Contributory to the impression of energy in his final style were his remarkable vocal flexibility, intensity of gaze, great fluency, and tremendous variety of gesture. Important, also, were his usual practice of speaking extemporaneously from notes and his belief that the ultimate creation of a speech depended upon the inspiration which the speaker drew from his audience at the moment of utterance.

From these studies it may be concluded that Gladstone's success as a speaker cannot be attributed to the quality of his ideas, which were generally unoriginal, or to his rhetorical style, which was unusually complex, but rather to the sense of deep conviction which he always conveyed, to his prestige as a long-established political leader, to his unfailing fluency, and, especially, to the peculiarly magnetic quality of his delivery. Essentially a debater, Gladstone found in political oratory a medium of expression for the intricate, argumentative cast of his mind and for the earnestness and sense of mission which were the prime elements in his character.

Though Gladstone's reputation as a speaker has not survived him, his speeches provide us with insight into the traditions of political speaking in the nineteenth century. With those of Disraeli, Cobden, Bright, and other representative speakers of the Victorian era, they form an important link in the history of oratory between the eighteenth century and our own. 329 pages. $4.25.

AN ANALYSIS AND EVALUATION OF FORENSIC CONTESTS AS CONDUCTED IN THE SECONDARY SCHOOLS WITHIN THE AREA OF THE NORTH CENTRAL ASSOCIATION

(Publication No. 25,436)

George Bradford Barber, Ph.D.
The Ohio State University, 1953

This study was undertaken to make an analysis and evaluation of the extracurricular forensic activities as practiced in the secondary schools belonging to the North Central Association of Colleges and Secondary Schools in an area made up of nineteen states. The states included

in this study were: Arizona, Arkansas, Colorado, Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, New Mexico, North Dakota, Ohio, Oklahoma, South Dakota, West Virginia, Wisconsin, and Wyoming.

A research questionnaire was used to gather the data. The State Chairmen of the North Central Association cooperated in mailing the questionnaires in eleven of the states, while in the remaining eight states the investigator sent questionnaires to every third school on the North Central Association membership list. A total of 2,241 questionnaires were thus distributed.

From this number, 853 or 38.06 per cent of the questionnaires were returned to the investigator. The largest percentage of returns were received from schools in Wisconsin and Arizona, while West Virginia and Ohio contributed the lowest percentage of participating schools. In the final analysis of these data, it was revealed that the returns from schools polled through the North Central State Offices exceeded by 7.9 per cent the returns from the schools polled directly by the investigator.

The research instruments were designed to secure information concerning extracurricular forensic activities from four basic sources: secondary school administrators, directors of forensics in the secondary schools, high school students actively engaged in forensics, and alumni who participated in forensic activities when they were in high school. Responses from the four groups of the population were tabulated as follows: secondary school administrators, 708; secondary school forensic directors, 685; secondary school students,172; and alumni, 73.

The questionnaire was prepared in preliminary form and submitted to fifteen faculty members of Illinois State Normal University as a means of testing the validity of the measuring instrument. These persons were selected because of their presumed understanding of the problems of the secondary school personnel who later would be asked to answer the questionnaire. They were instructed to evaluate the questions in terms of clarity of statement, readability, vocabulary, and ease of response.

Parts I and II of the revised instrument were then sent to twelve selected central Illinois high schools for a test run. The administrators and forensic directors in these twelve schools did not indicate any objections to the form or to the content of the questionnaire.

In an effort to determine the reliability and significance of the data drawn from the opinions of the respondents, two statistical devices, chi square and the Spearman rank-difference correlation were employed. These statistics when applied indicated highly reliable data were obtained in all but one instance.

The findings of the present investigation may be summarized as follows:

1. Returns of the questionnaire were well divided between the so-called large, medium, and small size high schools. When compared with the total school populations, the actual returns were slightly skewed toward the middle and large size high schools.

2. More administrators responded with evaluations of interscholastic activities than of intramural activities.

3. The data from the administrators indicated that the outcomes of forensic activities were equally developed in interscholastic and intramural activities; they were not willing, however, to have intramural activities substituted for interscholastic activities.

4. Problems of "financing activities," "supervision of students while on trips," and "time missed from school to attend contests" were generally rated "of no importance" by the administrators. They favored financing the activities with funds appropriated by Boards of Education.

5. Administrators reported almost 3 to 1 that forensic activities in their schools were conducted by teachers classified as other than "full time teachers of speech."

6. School time was reported as available for extracurricular activities, but it was difficult to arrange the time for such activities because of conflicting schedules.

7. "Substitute teachers," "other teachers taking charge of classes," and "sending students to the study hall" were checked as solutions of the problem of caring for forensic directors' classes when they were attending contests.

8. Forensics is primarily an upper class activity since freshmen participated in contests less frequently than upper classmen.

9. The tournament is the predominant and preferred form of contest organization.

10. "Lack of uniformity in judging" was the most difficult problem forensic directors encountered in forensic contests. The least difficult problem was "supervision of students while on trips." These data were in harmony with data submitted by administrators.

11. Forensic directors and administrators tended to agree that intramural programs were "slightly" to "definitely inferior" to the present contest system.

12. The directors indicated that the accepted objectives, "provide good library training," and "provide training in organizing materials," were developed in a noncompetitive forensic program, but the directors did not indicate that such a program developed the ability "to evaluate evidence."

13. The directors agreed that interscholastic contests make a contribution to most of the basic needs of youth.

14. The five forensic activities used in typical contests offer sufficient values to the students to be retained in secondary school contests. Extemporaneous speaking, original oratory, and debate were most frequently rated "extremely important."

15. Students and alumni showed more enthusiams for interscholastic competition than for intramural competition.

16. Original speaking events were believed to be "valuable," or "extremely valuable," by both students and alumni. More frequently than did the students, the alumni rated declamation "of little value."

17. "A recognition of the values to be gained from such participation" was most frequently given as the reason for entering contests. It should be noted that a higher percentage of the alumni gave credit to the administrators for guiding them into forensic activities than was true of the students.

18. Both students and alumni were opposed to abolishing interscholastic contests.

19. Both the students and the alumni indicated an awareness of certain problems to be met in interscholastic contests. Both groups indicated "too much emphasis on winning," "too few students participating," and "poor judging" as areas in which major problems exist.

20. In all four groups of respondents, it was preponderant opinion that interscholastic forensic contests should not be abolished.

These data indicate that the four groups reached by the

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questionnaires, the administrators, the forensic directors, the students, and the alumni, were willing to express themselves both pro and con concerning forensic activities. Furthermore, it is evident that forensic leaders should accept the challenge to provide a constructive solution designed to increase student participation and to improve the quality of the judging.

The data further indicate a widespread need for qualified teachers of speech. It seems apparent that school administrators should be encouraged to demand well trained personnel to direct interscholastic forensic activities. Perhaps this demand would stimulate teacher training institutions to provide curricular experiences for the preparation of teachers in these areas of speech.

A brief survey of the study indicates the close agreement of these respondents with the recommendations submitted to the North Central Association by The Speech Association of America. The analysis and evaluation of these data show that these respondents, as well as the leaders of the Speech Association are willing to cooperate in an effort to solve the problems arising from interscholastic contests. 328 pages. $4.20. Mic 58-4852

Abstract published by special arrangement with The Ohio State University.

ORAL COMMUNICATION IN EXECUTIVE BEHAVIOR IN A MEDIUM SIZED INDUSTRIAL FIRM IN DETROIT, MICHIGAN

(L. C. Card No. Mic 58-1173)

Chester L. Brisley, Ph.D.
Wayne State University, 1957

Supervisor: Dr. George V. Bohman

The purpose of this dissertation is to analyze executive behavior as it relates to oral communications in a medium sized company with the central offices located in Detroit, Michigan. This study is significant and distinctive because the company analyzed has a participating committee type management called "multiple management." Therefore, discussion is used to the fullest extent. The study introduces a methodology called "work-sampling" for measuring quantitatively the amount of communication taking place. Further, the study evaluated from a qualitative point of view through depth interviews the effectiveness of, as well as the approaches to, communication.

The top two levels of the executives of this Detroit company were studied by means of work-sampling to determine the amount of time that they expend on various elements of oral communication such as: consultation, deciding upon a course of action, discussion, interviewing visitors, telephoning, dictating, meetings, discussions at lunch, and discussions in the factory or other offices.

On the basis of this experiment the amount of time expended in these oral communication elements was eighty percent for Level One executives and eighty-five percent for Level Two executives.

Level One executives were sampled by random observations over a period of twenty-six days and Level Two executives were studied for a period of sixty-four days. Later, the majority of the same executives were interviewed by asking them approximately fifty questions pertaining to the qualitative aspects of oral communication within the multiple management organization.

On the basis of the data resulting from this study, principles pertaining to more effective oral communication within a multiple management organization were developed. 242 pages. $3.15.

THE SPEECHES OF LOUIS DEMBITZ BRANDEIS, 1908-1916

(Publication No. 25,437)

John Garber Drushal, Ph.D.
The Ohio State University, 1951

The purpose of the study is to present from the point of view of the rhetorical critic an analysis of some of the significant speeches of Louis Dembitz Brandeis during the period 1908 to 1916.

In modern times, ever since freedom of speech has been considered an inherent condition of a free society, public address has been one of the major factors in shaping the political and social patterns of any given era. While other methods of mass communication are now in vogue, Professor Wichelns has correctly pointed out that "human nature being what it is, there is no likelihood that face to face persuasion will cease to be a principal mode of exerting influence, whether in courts, in senate houses, or on the platform. It follows that the critical study of oratorical method is the study, not of a mode outworn, but of a permanent and important human activity."[1]

In the dissertation the basic Aristotelian pattern of criticism has been used, with some practical modifications. A chapter is devoted to the speaker. Another chapter is devoted to Brandeis' audiences in general, with the analyses of specific audiences coming in the chapters analyzing six specific speeches. In the chapters on these speeches there is also a discussion of their effect on the audience. These observations are summarized later in a chapter on the impact of Brandeis on his day. In the analysis of the speeches, the classical divisions of ancient rhetoric are followed. The type of criticism is essentially judicial.

The years between 1908 and 1916 might be called Brandeis' "National Period," the era when he began to achieve national stature, and in which he began to concern himself chiefly with national problems.

The year 1908 is marked as the beginning of this period because of the Oregon maximum hours law, which Brandeis defended before the United States Supreme Court.[2] During the eight succeeding years he engaged in many battles which contributed to his fame, gaining him the title "the people's lawyer."

Louis Dembitz Brandeis was born November 13, 1856, in Louisville, Kentucky. He was the son of Adolph and Fredericka Dembitz Brandeis, who had migrated to America from Austria in 1849.

Brandeis received his education in private and public schools in Louisville, attaining high marks in all of his studies. He spent two years (1873-75) in the Annen-Realschule in Dresden, Germany. Upon his return to America he entered Harvard Law School, which he attended

until 1878. No student there has ever received grades as high as those earned by Brandeis.

He set up law practice in St. Louis, but in less than a year returned to Boston and formed a firm with a friend, Samuel D. Warren. The partnership of Warren and Brandeis was dissolved in 1897, when the firm of Brandeis, Dunbar, and Nutter was established. Brandeis was a member of this firm until he was appointed to the United States Supreme Court in 1916.

Brandeis began to emphasize public service in his work about 1897. With the formation of the firm of Brandeis, Dunbar, and Nutter, much of the actual law practice was handled by his colleagues. This left Brandeis free to engage in a variety of causes and non-paying cases which were important to him. By this time he was financially independent. He was therefore able to give time and attention to these many interests.

In 1908, Brandeis presented the brief for plaintiff in the case of Muller v. Oregon[2] which set a precedent in pleading before the United States Supreme Court. He insisted that the Court take cognizance, not only of the law, the record, and precedents, but of all known facts and public knowledge on any issue in cases pending. This broad view of the function of the Court was accepted by the Justices, and what became known as the "Brandeis brief" was thereafter widely used.

In considering the other aspects of Brandeis' legal career, it must be emphasized that above all he was an individualist. He followed his own paths to ends of his own choosing. He represented whatever cases interested him and refused those which did not.

Brandeis was nominated to the United States Supreme Court by President Wilson on January 28, 1916. Between that date and his confirmation in June raged the most vicious and bitter controversy that has ever grown out of an appointment to that tribunal.

Two cases typify the point of view underlying his work on the Court. In Burnet v. Coronado Oil Company,[3] where a majority had based a tax decision upon stare decisis, Brandeis in his dissent gave a careful analysis of the effect of this doctrine upon the decisions of the court. It was clear that he did not feel the Court bound to place itself under the "dead hand of the past" in this stultifying manner.

A second case demonstrates Brandeis' implicit faith in the value of experimentation in government. In the New State Ice Company v. Liebman,[4] the Supreme Court overruled a license law in the state of Oklahoma which, it was contended, interfered with the right of any individual to manufacture ice as he pleased. The Court held that it was not constitutional "to dispense with this right in the interest of experimentation." Brandeis took this phrase as the thesis of his dissent. Government was not static to Justice Brandeis, something set in a mold. He urged that new ideas be tried. "If we would guide by the light of reason, we must let our minds be bold."[4]

Brandeis' career on the Supreme Court was guided by the two principles he discussed in these cases. He did not want himself or his government bound by precedent alone. Nor did he want to forbid government the right to experiment in the solution of its problems.

The audiences selected by Brandeis between 1908 and 1916 fall into six classes: (1) business and manufacturing organizations; (2) labor union leaders and members; (3) Congressional committees; (4) state and federal commissions; (5) religious conferences; and (6) organizations sponsoring ceremonial occasions.

The pattern of Brandeis' audience selection shows five traits or habits of choice. First, it reveals a paramount interest in the economic side of public affairs. Second, Brandeis demonstrated early that the careful selection of his audiences greatly increased the size of his following, and therefore he chose occasions with this prestige factor in mind. Third, the pattern of audience selection shows an interest in all phases of the industrial problems facing the democracy, whether involving labor or management. Fourth, the selection of audiences shows a keen interest in an attempt to ensure an enthusiastic support of democracy as a form of government. Finally, the selection of his audiences indicates his independence of thought and action.

During the period 1908 to 1916 Brandeis was at the zenith of his popularity as a speaker. In the year 1911, for example, he received more than 125 invitations from all over the country to address audiences of national importance. In 1912 he received a similar number. He declined most of them. He likewise declined two invitations to allow booking agents to schedule addresses for him. He was popular as a speaker in the Progressive movement until 1912. Later he was in great demand before audiences interested in Zionism. From 1912 to 1916 he had his choice of audiences and occasions for speaking.

Brandeis spoke in a period when the seeds of conflict were always present. In the political ferment of the times, the progressive ideal was a guide for many. The voices of protest and revolt had welcome audiences. It was in such a period that Brandeis attempted to influence opinion through his writing and his speeches.

Certain observations as to speech type and speech structure may be made on the basis of six typical speeches by Brandeis selected for analysis in this study.

In "The Ballinger Investigation" (delivered before a Joint Congressional Investigating Committee in Washington, May 27, 1910), in which Brandeis presented the closing argument in the inquiry, he demonstrated that he clearly sensed the importance of the occasion. He used the speech to impress not only the audience but the nation. He stated very clearly the issues before the committee. He outlined his argument so that they could follow it, and supported it with evidence from the record. He followed the classical pattern of organization. The peroration was in the nature of an appeal for better public service. The style was simple and direct, free from excesses of figurative language and strained analogies.

"The Five Per Cent Rate Case" speech (delivered before the Interstate Commerce Commission, April 30 and May 1, 1915) gave Brandeis an opportunity to repeat his theories of railroad management. Again, Brandeis demonstrated his ability to grasp the broad background of an issue and present material that pertained to his thesis. He showed a mastery of the clear style, with an especially unique method of making language reveal the meaning of statistics and complicated financial statements. He summarized his plea for "scientific management," holding that the highest ideal of community service demanded these goals of business and industry.

The speech on "The Constitution and Minimum Wage" (delivered before the United States Supreme Court, December 17, 1914, Stetler v. O'Hara, 243 U. S. 629) was an opportunity to summarize what he had long urged as the solution to a social problem. He answered the arguments of opposing counsel, using effective classical organization. Here he demonstrated more clearly than in many other speeches his effective argument by explanation. He kept

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his language appropriate to that of the greater national audience instead of limiting himself to the technical language of the Court.

In the Fourth of July oration on "True Americanism" (delivered at Faneuil Hall, Boston, Mass., July 5, 1915), Brandeis had an occasion on which he might have used more colorful language, more diversified stylistic devices. Instead, he gained an emotional response by very simple language. He used logical argument as the basis for his appeal. He did not succumb to the temptation to ornament his language to gain his desired end. His unique interpretation of American ideals was based upon his own economic theories.

"The Jewish Problem: How to Solve It" (delivered before the Eastern Conference of Reform Rabbis in New York City, June 2, 1915) is similar to Brandeis' other speeches in (1) its careful organization; (2) its clear analysis of the issues; (3) its well-supported arguments. In this instance he revealed his ability to understand and use the pathetic appeal effectively. He utilized a strong plea in his peroration, calling for an emotional reaction to his logical presentation.

The speech before the Chicago Bar Association entitled "The Living Law" (delivered at Northwestern University, January 3, 1916) is an excellent example of Brandeis' deliberative speaking before a select audience. It further illustrates his ability to state his issues clearly and drive immediately to the point. He used well-supported and forceful arguments, and quotation, to add emphasis to his exordium. The peroration was typically direct, almost blunt. The economy of style, characteristic of Brandeis, was evidenced by his presentation from a prepared manuscript.

In his inventional methods, Brandeis was guided by a tenacity of purpose which forced him to learn all the facts about a given issue before him. He became famous for his devotion to thoroughness. This trait was manifested in his preparation for speeches, as in all his activities.

In the organization of his speeches he usually moved from point to point with ease and force in an ordered plan. His speeches were models of clarity, partly as the result of style, but equally owing to the care with which he arranged his materials.

Brandeis did not speak in the cumbersome and dull style which one might expect from such a tenacious adherent to statistics and financial statements. He was able to make even these clear and interesting, an ability which contributed decisively to his effectiveness as a speaker. He avoided the four faults of style as set down by Aristotle: misuse of compound words, strange words, long untimely epithets, and inappropriate metaphors. Brandeis' language met the requirement of Quintilian that words be intelligible and appropriate. However, he seemed to succeed without using the diversified figures of speech listed by Quintilian. The Spencerian principle of the economy of style characterized Brandeis' writing and speaking more than any other single trait. He continuously strove to avoid wordy, confused, and intricate language. He relied upon simplicity and efficiency of arrangement to convey his idea to the hearer with the minimum of effort. Chief Justice Stone observed that "he was never willing to sacrifice clarity to the turn of a phrase, for he wished above all to be understood."[5]

Brandeis had a very good memory. He frequently memorized portions of his speeches with ease by the simple process of thorough research and care in phrasing. He spoke extemporaneously before the committees and commissions. He also memorized speeches for specific occasions. He seldom read an entire speech from a manuscript.

In the delivery of his speeches Brandeis was forceful and direct. He had a baritone voice which was very flexible and over which he had complete control. Brandeis was not a spellbinder. Neither was he flamboyant in delivery. He used few gestures. He spoke with vigor and firmness.

Brandeis made a significant impact upon the events and thinking of his day. He exerted an influence in at least five areas in which he was interested. (1) In his legal methodology he left a record which in itself became a chapter in American jurisprudence. He opened the door of the Supreme Court to "the facts of life." As "the people's lawyer," he demonstrated his philosophy that the law should represent the search of every man for the most effective participation in a democratic society. (2) He was effective in his battles with the railroads. (3) His vigilant battle with the trusts and large corporations affected their policies. (4) His influence in the field of social legislation was demonstrated by his successful handling of court cases involving social problems. (5) The Zionist movement was given a tremendous impetus by his work.

In a study of this kind the question must arise: Did Brandeis influence his day, or was he completely the product of his era? Five observations may be made in support of the conclusion that Brandeis had a truly important influence upon his time. (1) He was popularly recognized as the advocate of a specific point of view, the direction of which he helped to determine. (2) He made significant contributions to the methods used during the early part of the century. (3) Although he declined public office, he was offered several political positions, and considered for others, but turned them down in order to remain free to exert whatever influence he desired. (4) That this influence was determinative was conceded by his contemporaries. (5) Subsequent developments reflected the positions taken by Brandeis and showed the effect of his leadership.

A study of this kind suggests certain implications and conclusions to the student of rhetorical theory. They grow out of the analysis of Brandeis' methods, a study of his speeches, and the critical commentary on his work. Some of these follow.

a. Mastery of the facts and data in a given area are a valuable foundation for effective persuasive speaking.

b. People respond to public speaking on important issues when speeches are limited to bare statements of the facts.

c. A style which is characterized chiefly by clarity is widely accepted.

d. The almost complete absence of figures of speech does not necessarily lessen the effectiveness of a speech.

e. The absence of emotional appeals, pathetic proof, and colorful illustrations does not preclude a positive response from an audience. 534 pages. $6.80. Mic 58-4853

1. Wichelns, Herbert A. "The Literary Criticism of Oratory," in Studies in Honor of James A. Winans, A. M. Drummond, editor. New York: The Century Co., 1925, pp. 182–3.
2. Muller v. Oregon, 208 U.S. 412.
3. Burnet v. Coronado Oil Company, 285 U.S. 393.
4. New State Ice Company v. Liebman, 285 U.S. 262.

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At 306.

5. Stone, Harlan Fiske, C. J., 317 U. S. at xlviii.

Abstract published by special arrangement with The Ohio State University.

FIVE ORIGINAL DRAMAS

(Publication No. 24,382)

Wanda Clayton Thomas, Ph.D.
University of Utah, 1957

Chairman: Dr. C. Lowell Lees

This is a creative thesis of five original dramas, based upon historical research, and employing various styles and techniques. Three are one-act plays on "Mormon" themes for adults; two are three-act plays for children, adapted from short stories, set in a medieval background.

In 1945 under the auspices of a Rockefeller Humanities Foundation Fellowship, the material for the three "Mormon" plays was gathered with the express purpose of trying to preserve in dramatic form something of the dying pioneer culture of Utah. The gathering was done chiefly by word of mouth from the oldest residents along the main highways of Sanpete, Sevier, and Iron Counties, supplemented to some extent by readings done in the University of Utah Library and the California State Library in Sacramento, California.

Roughly, the interviews provided insight into (1) the problems of daily survival: finding and preparing food, providing shelter from the elements and the Indians, fighting illness and disease, and the grouping together in communal enterprize; (2) the problems incident to the spiritual struggles concurrent with a new religion and a new way of life; and (3) the comic problems that occurred in the mushrooming territory, especially among the Scandanavian immigrants. Out of these three categories came a pathos (They Shall Inherit the Earth), a tragedy (Vengeance Is Mine), and a farce (Heavenly Marriage).

Hans Clodhopper and the Princess, a satire on conformity, and Peterle, a religious melodrama on the meanings of love, were prompted by an effort to meet the demand for stage-worthy children's plays. The former was based upon the story "Hans Clodhopper" by Hans Christian Andersen. Peterle was based upon a story by the same name, written in the German language, by Herr Victor Bluthgen. Both were supplemented by readings in customs and manners of the Middle Ages. 208 pages. $2.70. Mic 58-4854

CHARLES KEAN: A STUDY IN NINETEENTH CENTURY PRODUCTION OF SHAKESPEAREAN TRAGEDY (VOLUMES I AND II)

(L. C. Card No. Mic 58-582)

Mardis Glen Wilson, Jr., Ph.D.
The Ohio State University, 1957

The specific purposes of the study were (1) to determine how Charles Kean, as manager of the Princess's Theatre in London from 1850 to 1859, conceived and interpreted Shakespearean tragedy, (2) to analyze the means employed by Kean in implementing his interpretations and objectives, (3) to present a pictorial representation of the productions, (4) to analyze the effectiveness of these productions in their time, and (5) to determine the contributions of Kean to staging of Shakespearean tragedy in the rest of the century. The study also broadly reflects general stage practice of the time and the role of Shakespearean tragedy in mid-Victorian culture.

A brief survey of the theatre and the status of Shakespearean production in the first half of the nineteenth century places Kean's work in the perspective of his age. His career prior to the management of the Princess's is traced, his managerial policies, objectives, and specific practices are cited, and his relations to the press are described. With this background, a separate chapter is then devoted to detailed study of each of the seven Shakespearean tragedies he produced at the Princess's – Hamlet, King John, Macbeth, Richard III, Henry VIII, Richard II, and King Lear. Prompt books for each production, pictorial evidence, the contemporary reviews, and other primary sources were examined to determine Kean's textual treatment and interpretation, his production practices, and the effectiveness of his staging of each play. Descriptive reconstructions of the staging are supplemented with eighty-seven photographs of selected pictorial evidence. Chapter X summarizes Kean's production practice in Shakespearean tragedy, and the final chapter indicates Kean's influence on the rest of the nineteenth century.

Kean's concept of Shakespearean tragedy was sentimental, didactic, puritanical, and melodramatic. His production methods, however, were impressive.

Although generally true to Shakespeare's language and Dramatic sequence, Kean omitted over one-third of Shakespeare's lines. He gave the tragedies special and original production, the most elaborate and carefully prepared that they had ever received. As a director, Kean achieved integrated production, worked for pictorial unity, employed new concepts of handling crowd scenes, and made great use of pageantry, sensual appeal, and inventiveness. Scenically, he employed spectacular and antiquarian realism, developed the use of the box set in tragedy, and introduced new scenic devices. In acting he contributed to the development of realism and ensemble in Shakespearean production. Kean's contributions to staging were broadly the same as those of the Meininger, which Kean preceded and influenced.

Kean succeeded in reviving interest in Shakespeare on the stage during his management, but his work also induced a marked decline in Shakespearean production after his retirement. Beginning in 1878, Irving again revived Shakespeare, large modeling after Kean, both in many specific details in staging the tragedies and in his general production practice. Charles Kean appears to have exerted the dominant influence on the late nineteenth century staging of Shakespearean tragedy.

527 pages. $6.70.

THE HOST RANGE PHENOTYPE IN T2 BACTERIOPHAGE

(L. C. Card No. Mic 58-877)

Oneil Mays Banks, Ph.D.
University of Michigan, 1957

T2 bacteriophage is a virus which is capable of attacking Escherischia coli strain B. It attaches to the outside of the bacterium, penetrates it, grows inside, and then the bacterium bursts open to release the progeny of the original virus. The period between attachment and burst is called the latent period.

When sensitive bacteria and virus are mixed and spread in a thin layer on an agar plate, the bacteria form an opaque blanket in which the virus make holes, or plaques, by attacking the bacteria.

By mutation bacteria may become resistant to T2. One of these mutants is B/2. Similarly mutation of the virus can enable it to attack the resistant bacteria. Such a virus mutation is called a host range mutation.

The aim of this study was to examine quantitatively and qualitatively the action of several host range mutations of bacterial virus T2. Previous studies of resistance of bacteria to bacteriophage had indicated that in most cases the phage is unable to attach to the resistant cell.

Dr. Martha Baylor isolated and located on the genetic map a series of thirteen host range controlling mutations (ht_1 - ht_{13}) at different locations. All of these produce the same outward effect (phenotype). An ht mutation at any location increases the host range of T2 only enough so that some phage are able to form very turbid plaques on E. coli strain B/2 which is normally resistant to T2. Two ht mutations at different locations can be combined in one bacteriophage by genetic recombination, and such phage produce less turbid plaques. If three ht's are accumulated in the same phage, it is able to form clear plaques on B/2 similar to those plaques formed by A. D. Hershey's T2h.

All the combinations of three of these ht mutations, ht_2, ht_{10} and ht_{11} were studied. Measurements of adsorption rate (rate of attachment of virus to bacteria) were carried out using a technique of simultaneous measurement with two other mutations with known rates of adsorption together with the unknown. The burst size (number of virus released when the bacterium bursts), the length of the latent period, and the efficiency of plating (ratio of the number of plaques on B/2 to the number on B) were also investigated.

Adsorption rates and efficiency of plating of the viruses depended only upon the number of ht's carried. No effect of position in the genetic map was observed between separate viruses with the same number of ht's. Number of virus released on burst and length of latent period were independent of number of ht's.

From this it was concluded that the ht mutations increase the adsorption rate and that this in turn increases the efficiency of plating and clarity of plaques.

This conclusion was tested experimentally by reducing the adsorption of T2h on bacterial strain B/2 through the use of low salt concentration. This was found to decrease the efficiency of plating and the clarity of the plaques thus supporting the previous conclusion.

This indicated that these mutations act through attachment which is known to be a function of the phage protein. Further studies of the nature of the changes produced in the protein by these mutations will give evidence as to whether amino acid sequence is controlled by mutation.

This is the first study known in T2 to correlate quantitative changes in virus action with quantitative differences scattered throughout the genetic map. The genetic composition of each virus used has been checked thoroughly by genetic crosses. Here then in T2 bacteriophage is quantitative evidence of the validity of the multiple factor hypothesis which states that quantitative changes in an organism are produced by additive action of several genes at different positions. 70 pages. $2.00.

THE LIFE HISTORY OF LEPTOPHYLLUM OVALIS BYRD AND ROUDABUSH, 1939 (TREMATODA), WITH REMARKS ON ITS TAXONOMIC AFFINITIES

(Publication No. 25,431)

William Michael Banks, Ph.D.
The Ohio State University, 1953

The dissertation is an account of the life history of Leptophyllum ovalis Byrd and Roudabush, 1939. It is the first life history to be worked out for a member of the genus, Leptophyllum. The experimental definitive host was found to be the snake, Natrix sipedon, a new reptilian host. The site of infection, likewise new for this trematode, is the rectum. The intramolluscan generations of Leptophyllum ovalis are miracidium, mother redia, and daughter redia. These develop in the snail, Goniobasis livescens Say. Cercariae were found to emerge from laboratory infected snails twenty-one days after the eggs had been ingested by this host. Cercariae were found to encyst, experimentally, in the muscle tissue of fish of the genus, Perca, within fifteen minutes, and less readily in tadpoles. Infection of Natrix sipedon resulted after it was fed experimentally infected tissues of the second intermediate host, Perca. The available information relating to the affinities and life histories of megalurous cercariae is summarized. The relationships of the genus, Leptophyllum, to the families, Echinostomatidae and Plagiorchiidae, are discussed. The erection of a new family, Leptophyllidae, is proposed for the reception of the genus, Leptophyllum.

51 pages. $2.00. Mic 58-4855

Abstract published by special arrangement with The Ohio State University.

The items following each abstract are: the number of manuscript pages in the dissertation, its cost on microfilm, and the Library of Congress card number. Enlargements 5-1/2 x 8-1/2 inches, 4 cents per page. No postage is charged if check or money order accompanies order.

AN ECOLOGICAL STUDY OF THE WOOD FROG, RANA SYLVATICA LE CONTE

(L. C. Card No. Mic 58-1105)

Edward David Bellis, Ph.D.
University of Minnesota, 1957

The ecology of the wood frog, Rana sylvatica Le Conte, was studied in a spruce and tamarack bog in northern Minnesota during the summers of 1954, 1955, and 1956. This widely distributed species was found in abundance in tamarack, black spruce and fir-ash habitats as well as the margins of upland ponds. Breeding took place in April; the eggs, which were tolerant of low temperatures, developed rapidly; the tadpoles metamorphosed during July and the young inhabited the shores of the breeding ponds for several days before emigrating to the lowlands.

The study was made in a 14,400 square yard area marked off in the form of a grid. Frogs were individually marked by toe clipping. A total of 1377 individuals were handled and 2101 captures were made. Capture-recapture data were analyzed for growth, movement, behavior, and population dynamics.

The average distance between adult capture sites was low, the median was 7.71 yards. A few individuals moved great distances. The amount of movement varied little between different sexes and sizes and between cover types. Many frogs had home ranges. The average size of the minimum home range was 77.2 square yards. Young of the year took up home ranges soon after immigrating. The distance between successive captures of young did not differ significantly from that of the adults. Many frogs either remained in, or returned to, the same home area during two successive years.

The males and females were approximately equal in number in the bog. The females averaged greater in body length than the males. The population was characterized by a high rate of turnover; the summer half-life of the adult population was 35 days. The young immigrated during August of 1954 and July of 1955; they made up a high percentage of the population in late summer. Between late August of 1954 and mid-June of 1955 the population size increased 113.8 per cent, probably due to the dry conditions that existed in 1955. The average size of the inhabitants of the portion of the area dominated by Calla palustris was smaller than the average size of the inhabitants of the portion dominated by alder shrubs in 1954, probably due to the standing water that prevailed in the calla area.

The growth rate decreased progressively with increasing body size. Frogs grew less during late August and early September than during warmer periods. Females normally reached sexual maturity two years after metamorphosis and began breeding when they reached three years of age. Males probably bred when two years old. The maximum age attained on the study area was at least four years.

A combination of physical factors, especially light, temperature, and humidity determined the activity periods of the frog. A negative correlation was found between the degree of activity and the vapor pressure deficit. Low temperature inhibited activity and probably conditioned frogs for hibernation.

Wood frogs rely on agility in movement, on camouflage, and on familiarity with the home range in escaping predators. The body color changes readily, depending on the moisture and light conditions. Wood frogs were more adept at escaping capture in the calla than in the shrub area. The principle predator in the bog was the common garter snake. Leopard frogs may eat many wood frogs.

Wood frogs feed on arthropods, snails, slugs, and earthworms. Most of the food consists of insects and spiders. Beetles, flies, and hymenopterans make up the principle food species.

The dorsal stripe was found in approximately 15 per cent of all individuals in the study area. Its presence or absence is genetically controlled. 169 pages. $2.25.

THE ARMYWORM, PSEUDALETIA UNIPUNCTA (HAWORTH), AND ITS NATURAL ENEMIES

(L. C. Card No. Mic 58-1318)

Samuel Glover Breeland, Ph.D.
University of Tennessee, 1957

Major Professor: Arthur C. Cole

The purpose of this dissertation is to report findings on the fundamental biology of the armyworm, Pseudaletia unipuncta (Haworth), based on a two-season study in Tennessee (1956-57).

Data were obtained from a combination of direct field observations, detailed insectary colony rearings, extensive light trap operations, and several controlled laboratory experiments.

Background material for the study is presented and includes a review of the literature, both the general and systematic histories of the species, geographical distribution, and known host plants.

The general life history is given for Tennessee along with a general description of the various life history stages and detailed biological data associated with those stages.

A key is presented for separating closely related species in Tennessee. All noctuid species which sometimes assume the armyworm habit are listed with their host plants and distribution.

An account is given of the seasonal cycle of the armyworm in Tennessee with emphasis on the overwintering status of the species in the state.

A section is included on the natural enemies of P. unipuncta in which all known parasites are listed and notes are included on those species reared by the writer. A summary of known predators and diseases of the armyworm is included.

The possibility of utilizing life history and seasonal cycle data for the establishment of a warning system against armyworm outbreaks is discussed.

A comprehensive bibliography of literature dealing with the armyworm from 1889 to the present time is included in the appendix. 232 pages. $3.00.

The items following each abstract are: the number of manuscript pages in the dissertation, its cost on microfilm, and the Library of Congress card number. Enlargements 5-1/2 x 8-1/2 inches, 4 cents per page. No postage is charged if check or money order accompanies order.

DIFFERENTIATION OF NYMPHS OF THE GENUS MELANOPLUS (ACRIDIDAE) IN FRANKLIN COUNTY, OHIO, AND THE VICINITY

(L. C. Card No. Mic 58-510)

Jay A. Buxton, Ph.D.
The Ohio State University, 1957

The nymphs of ten species of Melanoplus, collected from Franklin County, Ohio, and the vicinity, are described and compared.

At least one of the species can be identified in all instars by a single characteristic. The first and second instars of a few species cannot be separated at all morphologically. However, the majority can be distinguished with a knowledge of a combination of factors, such as the biology, ecology, distribution, morphology, and color markings. The later instars are usually easier to identify than the first and second instars.

Color pattern, although more variable in some species than in others, is quite reliable, and may be used equally well in separating the instars of both sexes. The most useful patterns are those on the femora, the lateral lobes of the pronotum, the genae, and the compound eyes.

A properly preserved reference collection is necessary for a study of this nature. Such a collection may be obtained by weekly field collections during the breeding season or by rearing the nymphs from eggs which have been deposited in the laboratory by adults collected in the field. Lettuce trimmings were used successfully as food for all species.

Live specimens may be preserved, and the color and color pattern retained, by quick deep-freezing. Specimens have been preserved for four years in deep-freeze without appreciable loss of color or color pattern.

The first three instars may be distinguished by the number of antennal segments, while a combination of the number of antennal segments present and the development of the wingpads are used to separate the fourth and fifth instars. 105 pages. $2.00.

AN ECOLOGICAL STUDY OF A GULF COAST MARSH, ROCKEFELLER REFUGE, GRAND CHENIER, LOUISIANA

(L. C. Card No. Mic 58-1319)

James Luther Chamberlain, Jr., Ph.D.
University of Tennessee, 1957

Major Professor: James T. Tanner

The purpose of the study was to describe the environment of an 86,000 acre coastal marsh, appraise the factors influencing local distribution of marsh plants, and to interpret the dependency of waterfowl upon the vegetation.

Precipitation, temperature, water level and evaporation were recorded. Soil salinity, determined from conductivity of extracted solutions, and water salinity were measured.

Heaviest rains were in the summer, and spring and fall were the driest seasons. Evaporation rates increased from winter to summer. Marsh vegetation significantly reduced evaporation. Surface soil salinities were greater and varied less than the overlying water. Seasonal variations of surface soil and water paralleled one another. Salinity was highest in early summer and in the fall, and lowest in winter and early spring. There was an inverse relation between salinities and water levels. Trends in evaporation agreed with changes in salinity. A slight vertical salinity gradient was normal in a brackish ditch but there was none in the shallow marsh waters. Gradients were more pronounced in canals but the gradients were variable.

The source of marsh water was almost entirely from rainfall. Water loss was normally through surface evaporation and transpiration. Water depths were greatest inland and decreased toward the Gulf. Winds profoundly affected water levels and tidal influence was negligible. Water levels were lowest in early fall. The pH of marsh waters was slightly alkaline and marsh soils were nearly neutral.

A map of the marsh vegetation was compiled and fresh-, brackish-, and salt-marsh zones were defined. Frequency distributions of marsh plants correlated well with soil salinities. Soils of the salt-marsh were azonal; brackish and fresh-marsh soils were intrazonal. Changes in marsh plant associations reflect adjustments to soil development, salinity, and water levels.

Mallards comprised 54 percent of the wintering duck population and blue geese constituted 92 percent of the wintering geese. The majority of the waterfowl population was on the area from late October to the following April. Waterfowl composition was different in various types of marshes.

Marsh plant utilization was determined by analysis of 1,251 gizzards from 17 species of wintering waterfowl. Differences occurred in items taken by ducks in different types of marshes. Forty-nine plants were identified from remains of food materials in the gizzards. Seeds of Cladium, Scirpus and Eleocharis were most frequently taken. It was concluded that utilization of food items depends primarily on their relative availability. 160 pages. $2.10.

CONTRIBUTIONS TO A CLASSIFICATION OF THE FISHES OF THE SUBORDER OPISTHOPROCTOIDEI

(L. C. Card No. Mic 58-1282)

Daniel Morris Cohen, Ph.D.
Stanford University, 1958

The present paper is divided into two sections. The first briefly discusses several morphological features pertinent to the classification of the Opisthoproctoidei. The spiral folds in the intestines of Argentina sphyraena and other species of Isospondyli are considered. It is concluded that this structure is not a definitive character of the Opisthoproctoidei.

The swimbladder of A. sphyraena is described and found to be separate from the gut.

Premaxillary teeth which have been recorded from Argentina are found to be papillae. Absence of premaxillary

teeth is a valid subordinal character in the Opisthoproctoidei.

Various features in the published accounts of the anatomy of Bathylagus and Dolichopteryx are reinterpreted on the basis of a re-examination of alizarin preparations.

The second section consists of systematic studies. A diagnosis of the Opisthoproctoidei is presented along with a review of the history of the group and a key to the families and subfamilies. The families Argentinidae, Bathylagidae and Opisthoproctidae are recognized and diagnosed.

The Argentinidae is recognized as including the subfamily Argentininae, genera Argentina and Glossanodon, and the subfamily Microstomatinae, genera Nansenia, Microstoma and Xenophthalmichthys. A systematic revision of the Argentininae, with a discussion of the distribution of the species is given. New subgenera, species, and a subspecies are described. In the subfamily Microstomatinae, a key to the nominal species of Nansenia together with tentative synonymies and a description of a new species are presented.

A review of the North Pacific species of the Bathylagidae is presented. Several currently recognized species of Bathylagus are placed in synonymy.

The family Opisthoproctidae is dived into the subfamily Dolichopteryginae, including the genera Rhynchohyalus, Macropinna, Dolichopteryx, and Bathylychnops; and the subfamily Opisthoproctinae including the genera Monacoa and Opisthoproctus. Specimens of Rhynchohyalus and Macropinna are described and synonymies are presented. Bathylychnops is described as new. Synonymies of Monacoa and Opisthoproctus together with notes on these genera are presented. 301 pages. $3.90.

A STUDY OF THE BIOLOGY AND LIFE HISTORY OF PROSEVANIA PUNCTATA (BRULLÉ) WITH NOTES ON ADDITIONAL SPECIES (HYMENOPTERA: EVANIIDAE)

(Publication No. 25,438)

Lafe Rees Edmunds, Ph.D.
The Ohio State University, 1952

The Evaniidae, as far as is known, are parasitic during their immature stages in the egg capsules of roaches. The hosts of the genus Evaniella are still unknown. Some evaniids parasitize the egg capsules of domestic roaches, and others the egg capsules of wood roaches. Two species are known to be parasites of domestic roaches in the United States, Prosevania punctata (Brullé) and Evania appendigaster (Linn.). Both species are believed to have been introduced into this country along with their hosts. Several species of the genus Hyptia are native to the Nearctic region. They are parasitic in the egg capsules of some of our native species of wood roaches.

The evaniid parasitizes the egg capsule after it has been dropped by the roach. The female of Prosevania punctata deposits a single egg in the roach ootheca by inserting its ovipositor through the hard outer ootheca covering. The time required for oviposition varies from 16 to 62 minutes. The immature stages of evaniids are spent in the egg capsule where the larva preys on the roach eggs, and the adult emerges by chewing a hole through the wall near one end. The only stage spent outside of the egg capsule is the adult, which lives for about twenty days. In captivity adults were fed successfully on honey water and flowers.

Oviposition by an unfertilized female Prosevania punctata was noted. A virgin female was observed ovipositing into Oriental roach Blatta orientalis Linn. capsules shortly after she emerged. The parthenogenesis was natural (spontaneous) and complete. Only male offspring resulted from the parthenogenetic egg depositions.

Evaniids were found to overwinter in the roach egg capsules. Hyptia thoracica Blanchard and Hyptia harpyoides Bradley overwinter respectively in ootheca of Parcoblatta pensylvanica (De Geer) and Parcoblatta virginica (Brunner). The overwintering stage of Hyptia was found to be the last instar larva, which pupates in early spring. Prosevania punctata overwinters as a last instar larva or pupa in the egg capsule of the American or Oriental roach.

The adults of Prosevania and Hyptia deposit a single egg inside of the ootheca which they parasitize. This egg is not inserted inside of a roach egg but is placed between roach eggs. The evaniid egg is spindle-shaped in outline and slightly curved, 1.26 mm. in length, and 0.25 mm. in width. The first instar larva is almost spherical in shape and develops to about 3.0 mm. in length and about the same in width. The second instar larva is more elongated and represents a more typical hymenopterous larva. The third instar larva is similar to the second but is larger and has more distinct segmentation and an evidence of wing and leg buds. The fourth and last larval instar is from 8.5 to 10.0 mm. in length, and from 3.8 to 4.5 mm. in width, and has nine fairly distinct tracheal openings from the first to tenth body segments. The head at this stage is well differentiated and wing and leg buds are evident.

The evaniid pupa is of an exarate type, and in the early stages is white in color. The abdomen is connected to the thorax by a broad base. As development continues the color gradually changes to black and the abdomen constricts at its base to form a narrow petiole characteristic of the adult.

In Ohio, where this study was made, the species of Hyptia appear to have a single generation per year. Hyptia thoracica emerges around the middle of June and adults can sometimes be collected during mid-summer. Prosevania punctata may have three or four generations per year, and adults can be collected from May until October. The first generation of punctata appears in late May and early June, and the other generations appear at about sixty-day intervals during the summer.

Examinations made of roach egg capsules after adult evaniids have emerged from them demonstrate a similarity in appearance and the result of parasitism. The contents of the ootheca are consumed during the period of larval feeding, and 8 to 40 potential roaches are destroyed. The number depends on the species of roach parasitized.

Hyptia thoracica or H. harpyoides was found in 6.7 per cent of the native wood roach capsules collected during the winter of 1950-1951, and in 2.8 per cent of the capsules collected during the winter of 1951-1952. Three other species of Hymenoptera, Systellogaster ovivora Gahan, Tetrastichus hagenowii (Ratz), and an undescribed species of Syntomosphyrum, and some Diptera, were also reared from wood roach egg capsules. Tetrastichus hagenowii was known previously only from domestic roach capsules. 87 pages. $2.00. Mic 58-4856

The items following each abstract are: the number of manuscript pages in the dissertation, its cost on microfilm, and the Library of Congress card number. Enlargements 5-1/2 x 8-1/2 inches, 4 cents per page. No postage is charged if check or money order accompanies order.

Abstract published by special arrangement with The Ohio State University.

THE DEVELOPMENT OF NECTURUS MACULOSUS

(L. C. Card No. Mic 58-911)

Kenneth Leonard Fitch, Ph.D.
University of Michigan, 1957

The general development of Necturus maculosus is described from fertilization through the 25 mm. embryo. Particular attention is given to those structures and processes which have not been adequately described by previous workers.

Necturus breeds in the fall. The female carries the sperms in the cloaca until the eggs are deposited in late April or May. The eggs are deposited on the underside of or rocks or boards, which serve as nest cover.

The egg of Necturus exhibits holoblastic cleavage, although the vegetal hemisphere is only indefinitely segmented until late blastula. The cleavage pattern varies among individual eggs.

Gastrulation is initiated by invagination. It is completed by simultaneous involution and epiboly at the dorsal lip of the blastopore and by delamination of yolk cells from the floor of the blastocoel.

The prechordal mesoderm is delaminated from the anterodorsal wall of the archenteron and gives rise to the mesoderm of the mandibular arches and to the mesodermal mesenchyme of the head.

The neural crest cells form a large mass in the head region. They are joined dorsally by lateral ectoderm to form the trigeminal, facial, glossopharyngeal, and vagal ganglia. The remainder of the neural crest breaks down into ectomesenchyme, which becomes the anterior part of the trabeculae and all the visceral arch cartilages except the second basibranchial.

When gastrulation is completed, the archenteron is a dorsoventrally flat cavity. The wall of the pharynx early sends five pairs of solid endodermal rods laterad. These become the visceral pouches. Behind the closed esophagus the liver diverticulum forms as a cranioventral hollow extension of the gut. The gastric enlargement forms concurrently with the liver. The primitive form of the remainder of the gut changes more slowly. The thyroid gland originates as a hollow diverticulum from the floor of the pharynx between the hyomandibular pouches. The diverticulum later fragments, resulting in a median and a pair of lateral accessory thyroid primordia.

The dorsal and the ventral pancreas develop separately, the former as a diverticulum from the mid-gut, and the latter as a diverticulum from the base of the ductus choledochus.

The lungs develop from a solid midventral evagination of the pharynx, directly behind the fourth visceral pouches.

The epidermis exhibits two cell-layers early. The inner layer gives rise to ectodermal placodes which form sense organs and ganglia, and elsewhere becomes the stratum germinativum, from which the integumentary glands develop. The outer layer becomes the stratum corneum.

The neural folds appear before the blastopore closes. Much of the early architecture of the brain is established during the period of closure of the folds.

The sense organs and hypophysis develop much as they do in other Amphibia.

The pronephros arises in the axial mesoderm before it divides into somatic and splanchnic layers. The pronephric tubules are metameric; the mesonephric tubules are not. Both nephrostomes and glomerular capsules form in the mesonephric tubules.

The branchial muscles form from branchiomeric mesoderm, which is continuous with the anterior wall of the pericardium. The hypoglossal muscles form from the myomeres of the second and third postotic somites.

Julia Platt's interpretation that the trabeculae and visceral cartilages originate from ectomesenchyme is confirmed. However, the observations in this investigation do not support her contention that lateral ectoderm contributes to the ectomesenchyme of the head.

The blood vessels form from anastomosing spaces in the ventral mesoderm. The first pair of aortic arches appear to arise from the endodermal wall of the pharynx. The sixth aortic arch is rudimentary, consisting of a transient ventral segment and a dorsal part which forms the pulmonary artery. 201 pages. $2.65.

FEEDING MECHANISMS, FEEDING HABITS, AND FOOD SELECTION IN ORTHOPTERA

(L. C. Card No. Mic 58-915)

Stanley Kenneth Gangwere, Ph.D.
University of Michigan, 1957

The literature on Orthoptera contains little information on their feeding mechanisms, feeding habits, and choice of food. The present study attempts to fill this gap in our knowledge by presenting the results of various observations and experiments made on a large number of species occurring in Michigan. It deals primarily with (1) the correlation between types of feeding habits and types of gut and mouthpart structure, and (2) feeding behavior, including food selection, food comsumption, and periodicity of feeding.

The mouthparts of 71 species are described, and representative ones are figured, many of them for the first time. The uses of the parts composing them are, for the first time, described in detail, this based upon direct observation of their actions in 43 species and upon the nature of the injuries inflicted upon the leaves of food-plants by 27 species.

The Orthoptera show three patterns of feeding which are here described for the first time. The Acrididae and Phasmidae are margin-feeders, the Decticinae and Copiphorinae are piercers, and the remaining groups are center-feeders. These feeding patterns are reflected in the structure of the mouth-parts and their action, the mandibles showing the most evident adaptive modifications.

The structure of the alimentary canal in the principal groups of Orthoptera is described and illustrated on the basis of published accounts supplemented by dissection of representative local species. It is pointed out that the various types of alimentary canal fall into two broad categories: (1) the linear canal characteristic of the Acrididae,

with which that of the Phasmidae may also be placed, and (2) the segmented and curved or convoluted canal of the remaining groups. The functional significance of this difference is here pointed out for the first time. The linear canal is correlated with margin-feeding habits and is essentially an adaptation for grass-feeding; in it elongate bites are aligned into a continuous food-mass which passes unbroken through the digestive tract. The convoluted canal is correlated with other feeding methods and is adapted for handling in a series of digestive steps a soft food-mass composed of small, irregular bites. The presence of the linear type of digestive canal throughout the Acrididae, Tetrigidae, and Tridactylidae is evidence that they are related, and it suggests their derivation from a common grass-feeding ancestor.

Food selection was studied by observation in the field, by analyses of crop contents and fecal materials, and by experiments performed in the laboratory. Although most species proved to be polyphagous, the herbivores show definite, consistent preferences which differ from species to species. Although food preferences among members of a given subfamily are most often rather similar, they show in some a fairly wide range. The range of food choice in each group is sufficiently wide to overlap that of other groups. The results of this study of food selection are in general conformity with those of Isely on Texas Acrididae and Tettigoniidae but were based upon species of a different fauna and include representatives of all major groups.

Comparatively minor phases of this study were the investigation of feeding periodicity and of the food consumption of selected species. The results accord well with previous work. The Orthoptera are here classified into diurnal, nocturnal, and incompletely nocturnal groups which have similar periodicities of feeding but at different times of the day. Food intake is shown to be primarily a function of body size, but it is proportionately greater in sexually mature males than in females on account of the greater activity of the former.

On the basis of these studies it is concluded that the range of feeding habits among the Orthoptera is greater than has been supposed by some, and that there is a marked over-all adaptation of both structure and behavior to the use of different types of food. 520 pages. $6.60.

THE DISTRIBUTION AND ROLE OF ARGINASE ACTIVITY IN THE DEVELOPING CHICK EMBRYO

(Publication No. 23,095)

Mark Goldie, Ph.D.
The University of Connecticut, 1957

The distribution of arginase activity in the developing chick embryo has been studied in an attempt to relate development of enzymatic activity to differentiation of various tissues. This enzyme is also of considerable interest in relation to urea synthesis as an excretory device of the avian embryo.

Arginase activity in homogenates of embryo, yolk sac and allantois, as well as liver, mesonephros and metanephros at various ages, was determined titrimetrically, using the Conway method for urea. Concomitant analyses for combined urea plus ammonia N in homogenates were also performed. Growth data are supplied as a frame of reference for accumulation of soluble nitrogenous excreta and for total arginase activity of the tissues examined.

The k values for wet weight and accumulation of urea plus ammonia N by the embryo are similar, agreeing with the conclusion of Clark and Fischer (1957) that protein combustion is an energy source in early development of the chick embryo. Urea formation is clearly important as an excretory mechanism for nitrogen. The presence of arginase activity in the chick embryo throughout development indicates that its functional role is urea synthesis. Specific arginase activities of the yolk sac and the allantois are lower than that of the embryo.

Distribution of specific arginase activity in tissues of the chick embryo from days 3 to 36 is uniform. Marked differences in activity occur, however, in the developing liver, mesonephros and metanephros. Histodifferentiation of these organs is accompanied by appearance of constant levels of arginase activity; these levels differ according to the tissue. The concentrations of urea plus ammonia N in these tissues suggest that arginase activity is correlated with the extent to which each tissue carries out urea synthesis. 64 pages. $2.00. Mic 58-4857

AN ANATOMICAL, HISTOLOGICAL, AND EMBRYOLOGICAL STUDY OF THE RETROCEREBRAL COMPLEX IN THE HONEY BEE (APIS MELLIFERA L.)

(Publication No. 25,442)

Blake Burdette Hanan, Ph.D.
The Ohio State University, 1952

The examination in situo of the structure of the retrocerebral complex in approximately two hundred adult bees and the microscopic study of all stages except the egg are the bases for the following findings:

1. Paired corpora allata.—One of the pair is on each side of the esophagus and posterior to the circumesophageal commissure.
2. A deeply bifid corpus cardiacum.—It is dorsal and medial to the corpora allata, and since the lobes are almost separated, each lobe may still be termed a "corpus."
3. Two previously unreported commissures extending between the corpora cardiaca. The more dorsal, the dorsal paracardial commissure, passes dorsal to the esophagus but does not communicate with the recurrent nerve. The more ventral, the ventral paracardial commissure, links the corpora cardiaca bypassing ventral to the esophagus.
4. A hypocerebral ganglion of reduced size. Whereas a hypocerebral ganglion was formerly thought to be absent in the honey bee, the finding of a region of the recurrent nerve in which more neuron cell bodies are located than elsewhere leads to the hypothesis that this ganglion is present, but reduced in size, rather than entirely absent.
5. A definite anterior terminus to the dorsal vessel. This ending is formed by the dorsal paracardial commissure, the corpora cardiaca, and the cardiacal bridge.
6. Two distinct histologic regions in each corpus cardiacum.

In addition, the study of this complex in the larval and

pupal stages of the honey bee leads to the following conclusions:

1. The corpora allata go through three definitely distinct cytological phases, the larval, the prepupal, and the adult.

2. The corpora cardiaca of the adult are really deeply bifid lobes of a single body, and they are formed of two tissues, neural and aortal epithelium. These tissues differentiate and form this body during the second, third, and fourth days after capping of the worker bee cell.

The techniques which were employed, and the cytology and histology of the complex in all stages but the egg are discussed. A bibliography of thirty-six references and twelve plates with twenty-two figures are included.

76 pages. $2.00. Mic 58-4858

Abstract published by special arrangement with The Ohio State University.

STUDIES ON THE EUROPEAN RED MITE ON APPLE IN OHIO

(Publication No. 25,448)

Howard William Hintz, Ph.D.
The Ohio State University, 1952

Introduction.—During the growing seasons of 1950 and 1951 the growth and decline of the mite populations of twenty commercial, experimental, and marginal orchards in Columbiana, Mahoning, and Wayne counties were regularly observed and, when possible, the causes of these increases and decreases were investigated. Mites and predators were reared in the laboratory and on small trees. Extensive laboratory tests were conducted to determine the ovicidal action of many of the newer organic insecticides and acaricides on mite eggs. The responses of the winter egg to outdoor conditions and to controlled temperatures were determined.

Life History.—The European red mite, Metatetranychus ulmi (Koch), is a major apple pest in most of the apple growing regions of the world. It is the only mite which causes commercial damage on apples in northern Ohio. Other leaf feeding mites, such as the two-spotted mite and the clover mite, are nearly absent in sprayed orchards, but the clover mite is the most common mite present on unsprayed trees and orchards. Leaf feeding mites of the genus Mediolata are sometimes abundant in unsprayed orchards.

The winter eggs of the European red mite hatch at the time apple foliage begins unfolding. This is usually about a month after the apple-grain aphid hatch (Fig. 1). The red mite hatch is completed just before the codling moth emergence begins. Clover mite winter eggs hatch a few days before those of the red mite.

During or near the end of the apple blossoming period, there is a brief interval of time when very few winter or summer eggs are present on apple trees. Since the egg is the most resistant stage, the mites are most susceptible to spray action at this time. However, the reproductive capacity of the mites is greatest at this time and survivors will give rise to large populations sooner than survivors of a late June spray.

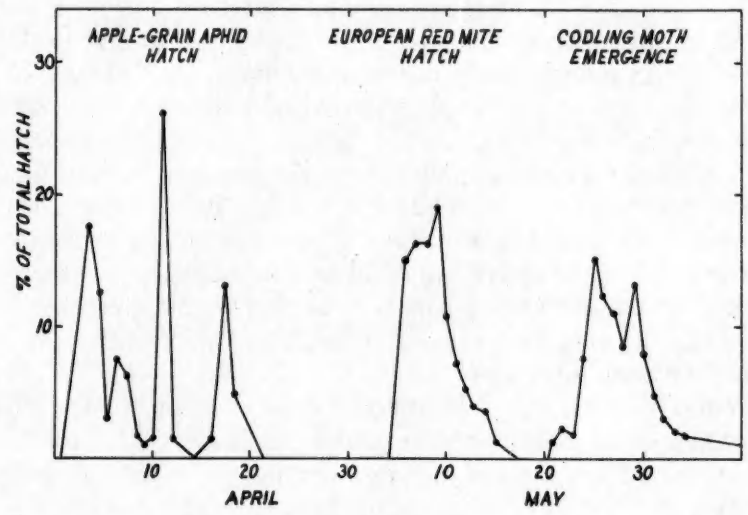


Figure 1. The sequence of appearance of several apple pests in the spring of 1950 in Wayne County, Ohio.

Summer eggs are produced from May to October and winter eggs are produced from mid-August until the first heavy frosts. Evidently more than one factor causes the production of winter eggs. Climate and day length are important influences for the first winter eggs appear at the same time on trees in varied situations over a wide area. The percentage of total egg production for the winter is modified by the quality of the apple foliage, which in turn is dependent upon the degree of mite injury, soil conditions, and cultural methods.

Temperature Relations of the Winter Egg.—Winter eggs are oviposited over a period of more than two months. They withstand exposure to extremes of winter temperatures and all hatch within a period of a week or two during the first extended warm period in the spring. The question arises as to how the spring hatch is synchronized.

If winter eggs are collected from the field in mid-November before there have been any marked cold spells, they largely fail to hatch when incubated at 70° F. A higher percentage of hatch occurs in eggs collected in December after there has been freezing weather or near freezing weather for several weeks. Such a hatch continues over a long period of about two months.

The hatching curve of eggs collected in mid-January begins to resemble that which occurs in the spring, but the mortality of January samples is still high compared to that of eggs of the same source collected and incubated in late February. By February the percentage of hatchable eggs is nearly at its maximum.

Examination of the data (Table 1) in more detail shows that the following behavior characterizes the winter egg when incubated at 70° F.

1. Very few eggs will hatch unless near freezing temperatures have existed for several weeks. Many eggs require a longer period of exposure. There is a wide range of response.

2. The minimal incubation time required for any egg is greatest among eggs collected in early December. Thereafter it decreases rapidly to a lower limit of about eleven days. This limit is reached early in January and remains constant through early March at least.

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Table 1. Condensed Record of Hatches of Field Collected Winter Eggs Incubated at 70° F.

Date Collected	Average Intervening Temperature	Per Cent of Total Hatch Completed 1	Days	50	Days	99	Days	Duration of Hatch	Per Cent Viable
11/20	--	-	-	-	-	-	-	--	2.6
11/29	23.2	-	-	-	-	-	-	--	2.2
12/6	39.8	1/9	34	2/1	56	2/24	79	45	18.3
12/12	26.2	1/14	33	2/1	51	2/28	77	44	12.0
12/20	20.3	1/3	14	2/15	57	3/3	73	59	28.6
1/2	22.3	1/12	10	1/31	29	3/3	60	50	23.4
1/11	30.7	1/21	10	2/1	21	2/24	44	34	42.0
1/21	35.8	2/2	12	2/13	23	2/23	33	21	37.0
1/27	25.6	2/8	12	2/17	22	2/26	30	18	48.0
2/13	19.8	2/26	13	3/3	18	3/14	29	16	52.0
2/24	37.1	3/6	11	3/12	16	3/19	23	12	84.0
3/10	42.7	3/20	10	-	-	-	-	--	high

3. The maximum incubation time for any egg is greatest in December. This maximum time decreases continuously through January, February, and at least part of March.

4. The time required for 50 per cent of the total hatch to be completed is greatest in early December and thereafter decreases continuously through January, February, and at least part of March. The maximum rate of hatch occurs at or near the time when 50 per cent of the total hatch is completed, with exceptions occurring in eggs collected in December.

5. The duration of the hatch increases in the latter half of December but decreases through January, February, and early March. The increase in late December is due to the minimal incubation time decreasing at a faster rate than the maximal incubation time (Fig. 2).

The European red mite egg thus reacts to winter temperatures in such a manner that it tends towards a state in which development will be completed after eleven days incubation at 70° F. Actually the average egg by the end of February develops to a point at which it will hatch after about two weeks of 70° F. incubation. The mechanics of this development are as follows:

1. No development directly affecting response to incubation occurs at the mild temperatures prevailing during October and early November. If eggs are kept at mild temperatures, they eventually deteriorate and do not hatch.

2. An important preliminary development occurs during near freezing temperatures. Low temperatures do more than break the diapause. More important, they produce a slow change in the egg which results in an increased rate of development at spring temperatures. After long exposure to near freezing temperatures, the rate of development of all eggs becomes nearly the same, whereas after a short exposure to low temperatures the eggs which do hatch upon incubation at 70° F. have a wide range of rate of development.

3. The preparatory development continues throughout the winter. It largely occurs in the temperature range between 32° and 50° F. Among individual eggs there is a wide range of time required for preparatory development. Most of the preparatory development is completed from

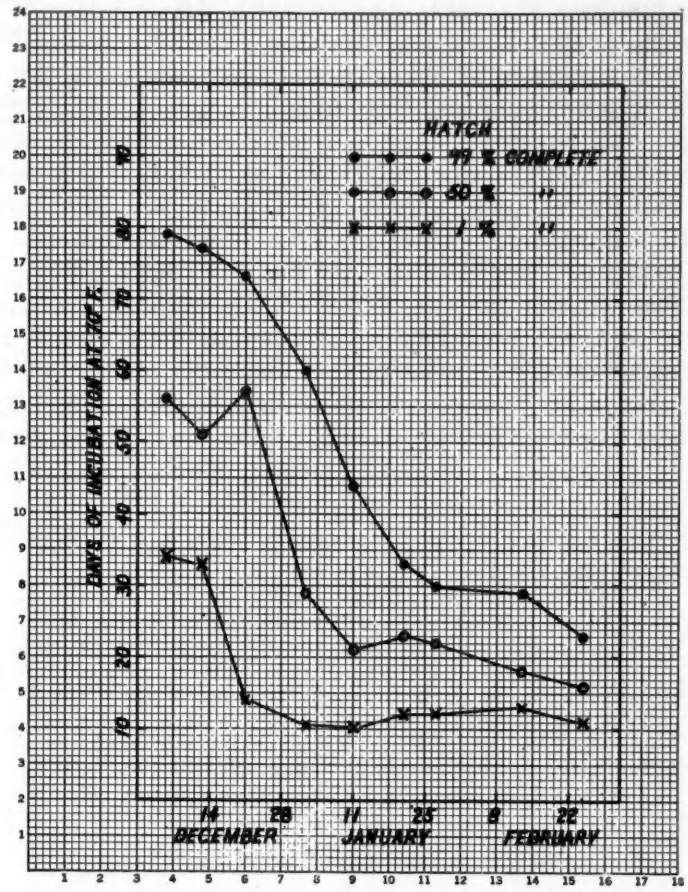


Figure 2. The varying response to 70° F. incubation of field collected European red mite winter eggs.

seven to fifteen weeks after the onset of winter conditions in the field.

Predation.—Little is known about climatic checks to red mite increase. No investigators have found evidence of significant stimulation of mite reproduction by DDT. A number of men have gathered evidence showing predators were responsible for low mite populations in unsprayed orchards, but other workers see no possibility of predator control in commercial orchards. Most workers agree that various sprays greatly reduce predator populations. This is probably a major reason why mites have become more troublesome in the last three decades.

Predacious Iphidulus mites are usually present in marginal orchards but are rare in sprayed orchards. Chrysopids are abundant and widespread but their influence is difficult to determine. Thrips and Stethorus lady bird beetles become very abundant in some sprayed orchards after the red mite increases. Predators evidently cannot control the red mite once it becomes abundant in an orchard, but they are probably responsible for maintaining mites at a low population level in many cases.

Life History of Stethorus punctum Lec.—The life cycle of this ladybird beetle is completed in about three weeks at summer temperatures. The overwintering stage is the adult and there are three or more generations a year. The egg hatches three days after oviposition. Each of the first three larval stages is completed in not much more than a day, and the last larval and prepupal stage occupies three or four days. After three days pupation the adult emerges. Copulation may take place within two days after emergence but the preoviposition period is at least seven days. Adult females commonly live six weeks and produce 150 to 250 eggs in that time. Egg production is closely correlated with the amount of food available. If no food is taken, the egg production immediately falls to zero. With abundant

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food a dozen eggs a day are commonly produced. One record of 19 eggs per day for two days was obtained.

Ovicidal Tests.—Extensive tests were made of the action of eighteen insecticides and miticides against the winter and summer eggs of the European red mite. In general, materials had the same relative effectiveness against the eggs that they showed against mite populations of mixed stages in the field. Winter eggs, when sprayed eleven days before the spring hatch began, required many times the concentration used against summer eggs for an equal amount of kill. Various organic phosphates and sulfonates were most effective as ovicides. Parathion was erratic in action and was shown to be more toxic to eggs 5 to 7 days old than to eggs 1 to 3 days old.

213 pages. $2.80. Mic 58-4859

Abstract published by special arrangement with The Ohio State University.

FACTORS AFFECTING THE ECOLOGICAL DISTRIBUTION OF THE ANTS IN THREE BOGS IN SOUTHEASTERN MICHIGAN 1957

(L. C. Card No. Mic 58-934)

Paul Bruno Kannowski, Ph.D.
University of Michigan, 1957

The ecological distribution of the ants inhabiting three bogs in southeastern Michigan is described. The nest sites and structures are described and correlated with the plant communities. Mating and colony-founding behavior was investigated to ascertain their relation to ecological distribution. An analysis of the various factors which control the occurrence of ants in bogs and which determine the distribution within bogs is presented. Certain physical and biotic features of the environment are briefly discussed.

Thirty-two species of ants were found in one or more of the bog plant communities. Sixteen of these species are recorded from this environment for the first time, one of them (Leptothorax duloticus) being a new record from Michigan. Another species (Myrmica species "A") could not be adequately determined, and may represent a new species. Bog ants occupied all of the non-aquatic plant communities. Ants were fewest in number of species and in number of colonies in the sedge-margin community. The largest number of species was found in the deciduous hardwoods swamp community, but the greatest number of colonies occurred in the sedgefern marsh.

Ants occupied a diversity of nest sites in bogs, from simple performed cavities such as hollow stems and curled leaves to complex masonry nests (mounds and domes). The kind of nest sites available varied in the several communities. Some ants were very restricted, others very plastic in their nesting behavior.

The mating flights of six species (Myrmica fracticornis, Tapinoma sessile, Dolichoderus mariae, D. pustulatus, Lasius minutus, and Formica fusca) are described for the first time. Significant information on the time of maturation of the alate forms is presented for most species. The methods of colony-founding utilized by bog ants are discussed and a classification of these methods and a list of the species using them are presented. Among the many new observations is the finding that Lasius speculiventris is a social hyperparasite, being parasitic on L. minutus which in turn is supposed to be parasitic on L. alienus.

The major factor preventing the occurrence of most upland species of ants in bogs appears to be the high soil moisture, although temperature and nest site restriction are also probably limiting factors in several instances. Within the bog environment light, soil moisture, and nest material are believed to be the principal factors limiting the distribution of ants. Mating and colony-founding activities, food, and air humidity are additional factors which may, directly or indirectly, affect the ecological distribution of bog ants. 275 pages. $3.55.

CERTAIN ASPECTS OF THE HOST-PARASITE RELATIONSHIP OF ASPICULURIS TETRAPTERA, A MOUSE PINWORM

(L. C. Card No. Mic 58-1350)

Allen W. Mathies Jr., Ph.D.
Columbia University, 1957

Aspiculuris tetraptera has been successfully used in attempts to find new anti-oxyurid agents. However, much of the host-parasite relationship is unknown. The life cycle is a simple, direct one as is characteristic of the oxyurids. This investigation was designed to ascertain if normal resistance phenomena exhibited themselves in the host-parasite relationship.

METHODS AND MATERIALS

All mice utilized were from a helminth-free colony of albino mice. Each animal was infected with a standard dose of 500 embryonated eggs, by oral intubation. All experimental animals were sacrificed 20 days post infection, and a comparison of the worm burdens in the colon served as the basis for the following observations.

HOST-SPECIFICITY

Four species of rodents were utilized, Mus musculus, Rattus norvegicus albinus, Peromyscus maniculatus bairdii, and Meriones unguiculatus. Comparison of the worms recovered from these hosts revealed that M. musculus is by far the best host. The average worm burdens for these four species is as follows: M. musculus – 182/mouse; R. norvegicus – 9.1/mouse; P. maniculatus – 0.0/mouse; and M. unguiculatus – 2.3/mouse.

AGE RESISTANCE

Mice of different ages were each infected with 500 eggs of A. tetraptera. Comparison of the worm burdens indicates that the age of the host and the infection rate are inversely related. The worm burdens are given in Table 1.

SEX RESISTANCE

As can be observed in Table 1, male mice are much more susceptible to infection with A. tetraptera than female mice. In order to ascertain what factors associated with the sex of the host were responsible, experiments were designed to 1) remove the source of hormone, and 2) to supplement the normal amount of hormone. Twenty-one day old animals were surgically gonadectomized

TABLE 1

Worm burdens in mice of different ages infected with 500 eggs of Aspiculuris tetraptera.

Sex of host	Age of host in weeks							
	3	4	5	6	10	17	20	24
male	252	210	82	51	62	22	33	9
female	114	22	16	15	71	15	6	16
both sexes	182	123	58	33	67	18	16	12

and then infected with A. tetraptera. This gonadectomy resulted in a significant lowering of the worm burden in both sexes. No explanation for this observation is known at the present. In the other experiment physiological doses of artificial hormones were administered to animals throughout the period of their infection. A comparison of the worm burdens revealed that estradiol is deleterious to infections in male mice, Table 2.

TABLE 2

Worm burdens in mice receiving artificial hormones after being infected with 500 eggs of Aspiculuris tetraptera

Sex of host	Hormone given	Worm burden
male	control	173
female	control	85
male	testosterone	177
female	testosterone	110
male	estradiol	100
female	estradiol	107

In order to further elucidate some of the properties of this sex resistance, 12 day old animals were exposed to total body roentgen radiation. Although the experiment was designed to simulate surgical gonadectomy, it is obvious from the worm burdens, Table 3, that this was not the case.

TABLE 3

The effect of total body X-ray of mice on infections of Aspiculuris tetraptera

Infecting dose 500 eggs

Sex of host	Amount radiation given	Worm burden
male	control	243
female	control	100
male	200 r	370
female	200 r	69
male	400 r	321
female	400 r	214

CONCLUSIONS

1. A. tetraptera is a fairly specific parasite. 2. The mouse develops an age resistance to infection with A. tetraptera. The mechanism of this resistance is unknown, but it may well be related to the appearance and level of gonadal hormones in the host. 3. The sex of the host has a modifying influence upon the intensity of infection with A. tetraptera. Estradiol in male mice is detrimental to the establishment of a heavy infection, while testosterone seems to have little or no effect. 4. Total body x-irradiation changes the physiology of the host sufficiently so that experimental infections with A. tetraptera are characterized by a significantly higher worm burden.

103 pages. $2.00.

STUDIES ON THE ANATOMY, ECOLOGY AND GROWTH OF LYMNAEA HUMILIS SAY

(L. C. Card No. Mic 58-954)

Bruce Maxwell McCraw, Ph.D.
University of Michigan, 1957

The anatomical studies of Lymnaea humilis included a description of topographic features, the cephalic hemocoel and the reproductive system. Special attention was given to the nervous system, particularly the nerves arising from the pedal ganglia and innervating the foot. Fourteen new nerves were named.

The ecology of Lymnaea humilis was investigated in three different habitats: a mud flat, a river bank and a pond. The mud flat was found to be the preferred habitat. A definite zonation of Lymnaea humilis occurred on a mud flat. The concentration of this snail was greatest about 80 centimeters from the edge of water. This zonation was evidently related to moisture and available food. There was generally a greater percentage concentration of smaller snails near the water's edge than on the landward reaches of a mud flat. There was no diurnal migration of this snail. It was very susceptible to drying in the laboratory, and survival of drought in the field depended on the water retaining properties of the soil, the degree of exposure, and age of the snail. Laboratory observations indicated that the snail does not select more moist situations as artificial drought sets in.

Quantitative sampling methods showed that Lymnaea humilis was always less abundant in water than on land, both seasonally and throughout different times of the day. Survival under water depended on temperature; at room temperature the snail soon died, at 4 or 5 degrees Centigrade, snails were kept alive for about six months. It was concluded that this mollusc is not well adapted to either a completely aquatic existence or to a truly terrestrial one.

Oviposition occurred at the land-water junction, both in and out of water, but the greatest number of egg masses was always seen on land. Egg-laying does not begin until the shell reaches a length of 4 millimeters. Although ovipositing can be divided into distinct spring and summer phases, it was found to be a continual process as long as the temperature remained above 10 or 12 degrees Centigrade. Copulating snails were not seen in the field but were observed in the laboratory.

The concentration of snails on a mud flat varied seasonally. It was highest in late summer and early autumn when concentrations of over 220 snails per square decimeter were present. The distribution of Lymnaea humilis in water did not vary throughout the year nor was there any

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evidence that it migrated to water with the onset of winter conditions. Lymnaea humilis lived as long as nine months in the region of Ann Arbor, Michigan.

Both the male copulatory organ (preputium and penis sheath) and the oothecal gland of the female system changed their respective rates of growth after a shell length of about 5 millimeters is attained. These rate changes coincide closely with the onset of sexual maturity.

164 pages. $2.15.

CHAETOGNATHA OF THE FLORIDA CURRENT OFF MIAMI

(L. C. Card No. Mic 58-1446)

Harding Boehme Owre, Ph.D.
University of Michigan, 1957

The study was undertaken in order to investigate certain aspects of the ecology of Chaetognatha which inhabit the Florida Current off Miami.

Plankton collections taken from surface waters and depths down to 350 meters at a station located 10 miles east of Miami during the period from June 19, 1950, to February 4, 1952, provided material for studies of relative abundance of species, seasonal variation in abundance and vertical distribution, and breeding periods. Material for a study of diurnal migration was obtained during a 24-hour period by sampling depths from 0 to 731 meters at a station 40 miles east of Miami. Samples collected from the inner edge of the Gulf Stream north of Cape Hatteras were compared with samples taken off Miami as to number of species present and their relative abundance.

In order of relative abundance, species occurring at the 10-mile station are: Sagitta enflata, S. serratodentata, S. minima, Pterosagitta draco, S. bipunctata, Krohnitta pacifica, S. decipiens, S. hispida, S. hexaptera, S. lyra and K. subtilis, S. helenae, and, each forming less than 0.1 per cent of the total, S. plactonis, S. macrocephala and Eukrohnia hamata. With the exception of S. helenae and E. hamata and the addition of E. fowleri, these species also were collected at the 40-mile station.

Minor differences were found in the species present in samples taken from a northern part of the Gulf Stream System compared with those collected off Miami. Sagitta enflata was relatively much more abundant in the northern than in the southern samples.

Species collected in adequate numbers at the 10-mile station showed seasonal maxima in abundance which usually occurred in summer and sometimes also in another season. The maxima of some species coincided generally with their major breeding periods.

Differences in relative abundance of species suggest the presence at the 10-mile station of neritic influence which is lacking at the 40-mile station.

No correlation was found between periods of abundance of any species and percentage of either the Gulf of Mexico or Yucatan components of the Florida Current at the 10-mile station. However, it is suggested that Sagitta hispida may be an indicator of Gulf water under certain conditions.

Vertical distribution was highly variable seasonally. The depths at which the major concentrations of each species live were much greater at the 40-mile than at the 10-mile station. It is believed that this results principally from reaction to temperature; isotherms slope downward very steeply from the western to the eastern side of the Current.

Examination of the samples collected at the 40-mile station showed that Sagitta enflata, S. hexaptera, S. lyra, S. serratodentata and Pterosagitta draco undergo diurnal migration. There is also evidence of diurnal migration by S. decipiens, Krohnitta subtilis and K. pacifica.

From a study of length and maturity stages, it is concluded that length is not a generally useful index of stage of maturity and that several species may have more than one reproductive period in a lifespan. Data on length at each stage of maturity of species collected in both the Florida Current off Miami and the colder waters off southeastern Australia indicate that the animals may mature at a smaller size in tropical oceanic waters. Evidence is given that six of the Florida Current species breed more or less continually throughout the year in addition to their major breeding periods and that two breed only at certain seasons. There were insufficient data to determine the spawning periods of remaining species. Observations indicate that the presence of a parasite in the coelom may inhibit gonadal development. 221 pages. $2.90.

MORPHOLOGICAL AND BIOCHEMICAL EFFECTS OF SELECTED METABOLIC FACTORS ON RAT LIVER MITOCHONDRIA

(L. C. Card No. Mic 58-626)

Judith Dunlap Pratt, Ph.D.
Duke University, 1958

Supervisor: Henry S. Roberts

The fact that the morphology of the mitochondria can be altered by various experimental conditions has long been recognized and extensively studied, but there has never been a satisfactory explanation of the significance of these changes. The present study was carried out in order to re-examine this phenomenon in light of the recent accumulation of evidence for a high degree of organization within the mitochondria.

Experiments were carried out to ascertain the effect of the following on the morphology of rat liver mitochondria; basic diet plus complete vitamin supplement; niacin, choline, inositol, and riboflavin deficient diets; and 2,4-dinitrophenol. Control animals were maintained on dog checkers.

More extensive studies were carried out on rats given the niacin deficient diet in order to determine if changes in the chemical composition of the mitochondria could account for the morphological changes observed. In addition to the cytological study of fixed and stained tissue, liver homogenates were fractionated by differential centrifugation and the following fractions obtained: nuclei; mitochondria; mixed fraction, containing small mitochondria and submicroscopic particles; and supernate. The homogenates and all fractions were analyzed for total nitrogen and phosphorus. The phosphorus compounds were fractionated and the acid-soluble, phospholipid, nucleic acid, and phosphoprotein fractions analyzed for phosphorus.

Nuclear counts and a determination of the percentage of mononucleate and binucleate cells were made to determine if the accumulation of fat caused any decrease in the number of liver cells per unit weight of tissue.

Analyses from the niacin deficient animals showed a significant decrease in the total nitrogen of the liver homogenates and all four fractions. There was also a decrease in total phosphorus in the homogenates, nuclei, and supernates. In no case was there a significant difference between rats given the basic and niacin deficient diets. Results of the nuclear counts and the determination of mononucleate and binucleate cells were not significant.

Since phosphorus content of isolated mitochondria remained remarkably stable, the evidence does not suggest that the morphological changes observed in the mitochondria were related to changes in their chemical composition.

Liver mitochondria seen in histological sections from control animals were predominately short rods. Tissue sections from rats given the niacin deficient diet contained spherical or irregularly shaped mitochondria accompanied by increased amounts of liver fat, while the appearance of sections from animals on the basic diet were intermediate between these two groups. The evidence suggests that the results obtained with the niacin deficient diet were due in part to the high sucrose content of the basic diet.

Animals on choline and inositol deficient diets developed extensive fatty degeneration of the liver, however, liver mitochondria in choline deficient animals appeared to be predominately spherical while those from the inositol deficient animals were either long rods or filaments. The presence of rod shaped mitochondria in the livers of inositol deficient animals may be related to the accumulation of cholesterol.

Histological sections from both the riboflavin deficient animals and those given 2,4-dinitrophenol showed finer and more filamentous mitochondria near the central vein while cells in the periphery of the lobule contained uniformly rod-shaped mitochondria.

The results of the present experiments suggest that changes in mitochondrial form are indicative of the type of metabolic activity being carried out by the mitochondria. Evidence from this study indicates that spherical or irregularly shaped mitochondria may be coupled with the synthesis of fatty acids, while rod-shaped mitochondria may be associated with increased oxidative phosphorylation.

108 pages. $2.00.

A STUDY OF VARIATION IN IGUANID LIZARDS OF THE LEIOCEPHALUS CARINATUS COMPLEX

(L. C. Card No. Mic 58-975)

George Bernard Rabb, Ph.D.
University of Michigan, 1957

The purpose of this study is the analysis of geographic variation in the West Indian lizards of the Leiocephalus carinatus complex. This group is defined as including L. greenwayi, of East Plana Cay, and the several races of L. carinatus, which occur on the Cayman Islands, Isle of Pines, Cuba, and islands of the three major northern Bahaman banks.

Of the numerous characteristics of scuttelation and proportion investigated, five were chosen for intensive multiple character analysis on the basis of their low interdependence, obvious variability, ease of definition, and adaptional significance. The morphological divergences among 19 samples of males and 25 of females, each of which numbered eight or more individuals, were determined by use of Mahalanobis' generalized distance function (D^2), as described by Rao. The coefficient of divergence of Klauber and Clark was also computed for the samples of males.

Very similar results were obtained from the two methods. Considering the relative amount of labor involved, it appears that the coefficient of divergence would be more efficient, if less rigorous, than the distance function for many problems in which there is no marked correlation between the characters.

Statistically significant differences in D^2 were found between most of the samples. A low correlation was found between amount of divergence (D) and actual distance in miles between the samples. However, the groupings of samples with little morphological divergence among them corresponded to the geographic distribution of the islands with respect to the banks upon which they are located. In three cases groups on different banks relatively close geographically were quite divergent. Consideration of color patterns indicates that these pairs of groups are closely related. This seemingly paradoxical situation is interpreted as being the result of different rates of change in the different characters. The major differences between groups of samples and conversely their closeness of relationship are apparently more related to past geography than to present distances and chances for dispersal.

A conjectural history of the Bahamas during the Pleistocene, based on scattered literature evidence and presumed similarity to Floridian history, indicates that L. greenwayi, the most distinctive member of the complex, has probably evolved from carinatus stock within about 90,000 years. Many minor differences in scuttelation appear to be related to the present geography, which is thought to have taken form in the past 10,000 years. Some of the differences of intensity of coloration are also believed to have arisen within this period. They are interpreted as examples of concealing coloration.

It is pointed out that melanism of a non-concealing type, high numbers of body scales, reduction in size and in degree of sexual dimorphism occur in peripheral populations, findings in accord with Mertens' comprehensive study of insular reptiles. Protection against radiation is suggested as being the probable adaptational reason for the first of these phenomena.

Intrageneric competition is proposed as a causative factor for the difference in caudal coloration of Cuban carinatus from all other populations.

The more important taxonomic considerations suggested are that L. greenwayi was derived from L. carinatus stock; that L. c. punctatus (including L. c. helenae and L. c. picinus) is likely of specific rank, although retained as a subspecies of L. carinatus for lack of critical material; that L. c. hodsoni be treated as synonymous with L. c. virescens; that the range of L. c. coryi encompasses the several islands of the northwestern arm of the Great Bahama bank; and that unnamed subspecies occur on the Ragged Islands and on Cayman Brac. 178 pages. $2.35.

The items following each abstract are: the number of manuscript pages in the dissertation, its cost on microfilm, and the Library of Congress card number. Enlargements 5-1/2 x 8-1/2 inches, 4 cents per page. No postage is charged if check or money order accompanies order.

A REVIEW OF TERTIARY RODENTS OF THE FAMILY HETEROMYIDAE

(L. C. Card No. Mic 58-976)

William Glase Reeder, Ph.D.
University of Michigan, 1957

Within recent years the phytoecology of the major Tertiary environments of Western America has been discussed and described by numerous paleobotanists. These workers have made inferences as to the climatic, physiographic, and vegetational features of the environments at and near sites of deposition of particular fossil floras. These data have been largely ignored by zoologists in their analyses of zoogeographic patterns exhibited by various animal groups. The purpose of the present study was the application of this store of evidence in the examination of a distributional pattern of a mammalian phylum.

Rodents of the family Heteromyidae were chosen as the subject of analysis for several reasons. Primarily, the group is rather well represented by fossil materials. Secondly, Recent members of the family are widespread in North and Middle America, being found in arid and semi-arid temperate, as well as arid to mesic tropical, environments. Additionally, the systematics of Recent genera, though not up to date, are comprehensive.

A complete re-evaluation of the paleontological evidence bearing on the evolution of this family has been necessary. All of the available material of Tertiary heteromyid rodents was assembled for study. Much of this is here reported for the first time. The relationships of the species are interpreted primarily on the basis of the structure of the teeth, rami, and, where available, the cranium. Study of the suite of specimens revealed five new genera, Apletotomeus, Akmaiomys, Dynastikomys, Trogomys, and Haltikosomys, and eleven new species, Apletotomeus crassus, Akmaiomys incohatus, Trogomys rupinimenthae, Perognathus depressus, Peridiomys cordialis, Haltikosomys nenzelensis, Haltikosomys aspiratus, Haltikosomys arrosor, Haltikosomys mascallensis, Perognathoides avawatzensis, and Perognathoides continentalis. Using the data derived from a systematic study of new as well as previously known material, a phylogeny of heteromyid genera is inferred.

A section is concerned with a review of climate and phytoecology of western North America during Tertiary time. The data forming the basis of this account of paleoecology were drawn largely from the extensive literature of paleobotany. Since the occurrence of plant and animal fossils in the same sediments is rare, the environment within which an animal assemblage lived usually was deduced on the basis of contemporary floras of adjacent regions.

The present interpretation of the relationships of genera within the family Heteromyidae differs in several respects from that of previous investigators. The perognathine line, for instance, appears to have long been distinct from the Dipodomyinae. The latter group seems to have derived from a position closer to the Heteromyinae. It is suggested that Microdipodops evolved from the Perognathoides-Cupidinimus complex and is the sole living representative of that group. The previously-accepted phylogeny, deriving the family from the Oligocene genus Heliscomys, indicates that the genus Perognathoides is closely related to Perognathus, Cupidinimus was ancestral to Dipodomys, and Diprionomys was related closely to the heteromyine line. The phylogeny as presently inferred differs in several other respects which have been discussed in detail.

The phylogeny of this family of rodents, as determined by analysis of morphology of the component genera and species, is correlated with the paleoecology of the regions within which the groups evolved. The genera are shown to have diverged largely in conjunction with the plant environments which were segregating during Tertiary time in response to the climatic trend to cool dryness. The necessity for use of paleoecological data by neozoologists, attempting the interpretation of animal phyla through time, is considered of prime importance.

644 pages. $8.15.

INVESTIGATION OF THE POSSIBILITY OF SELECTIVE CHEMICAL CONTROL OF LARVAL PETROMYZON MARINUS LINNAEUS

(L. C. Card No. Mic 58-982)

Philip John Sawyer, Ph.D.
University of Michigan, 1957

The sea lamprey, Petromyzon marinus Linnaeus, became a problem of economic importance in the Great Lakes within two decades after its discovery in Lake Erie during 1921. The United States Fish and Wildlife Service, with State and Canadian cooperation, undertook the task of providing ways of controlling the populations of this parasite. One facet of the attack was the beginning of investigations concerning the possibility of selective chemical control of the larval lampreys in the streams tributary to the Great Lakes.

To accomplish this, sources of experimental chemical compounds were established, and a rapid screening procedure was developed for testing them. Goldfish and larval lampreys were exposed simultaneously in the same containers to various concentrations of the toxicants which were added to three liters of water. One hundred and seventy nine substances were tested. Among these, four were found to be most selective for the larval lamprey, 36 were most toxic to the goldfish, 53 were equitoxic to ammocetes and goldfish and 86 were non-toxic at the concentrations tested.

The four most selective toxicants killed ammocetes in concentrations ten times as dilute as those that killed goldfish. They were as follows: The sodium salt of N-4-nitrophenyl-4-chlorobenzene sulfonamide, (Cr-1675); p-chlorobenzenesulfon-p-nitroanilide, (Cr-1674), the free acid from which the preceding toxicant was derived; benzylphenyl dimethylammonium 2, 4 dinitro-6-methylphenoxide, (Cr-353); and the sodium salt of 2-methyl 4, 6-dinitrophenate, (Cr-352).

A more careful analysis of these four toxicants was made in a constant temperature room, in 15 liter aquaria. Young-of-the-year Salmo gairdneri were used as comparative test animals instead of goldfish. Cr-1675 proved to be the most selective, but it was only slightly more toxic to larval lampreys than to rainbow trout.

Various pathological manifestations, such as excessive slime production, stasis of blood in the gills and heart, cutaneous and sub-cutaneous vaso-dilation and collection

of blood in the cloacal lips appeared in the lampreys during the experimentation. Efforts to explain these symptoms were made. Histological sections of gill and epidermal tissue were prepared. These were stained to pin point the fate of the slime secreting cells which have been judged to be important first-line defenses of the fishes against toxic substances. Examination showed that in many cases these cells had been destroyed or apparently inactivated. The mucus producing cells of the gills proved to be more sensitive than those of the epidermis.

The progressive failure of the circulatory system, which was macroscopically observed accompanying death of many of the ammocetes, was seen also under a microscope. The breakdown was caused by vaso-dilation, which in turn was responsible for a slowing and collecting of red blood cells in crucial places within the blood vessels of the larvae.

The investigation showed that selective chemical control of larval Petromyzon does have decided possibilities. Suggestions that concerned future experimentation in this field were made. 280 pages. $3.60.

A STUDY OF THE FOREST TENT CATERPILLAR, MALACOSOMA DISSTRIA HBN., AND ITS PARASITE COMPLEX IN ONTARIO

(L. C. Card No. Mic 58-1461)

William Lloyd Sippell, Ph.D.
University of Michigan, 1957

This investigation concerns the forest tent caterpillar and its parasite complex. Knowledge of the life history and ecology of the insect is reviewed and supplemented by facts derived from field observations, rearing experiments, and records from the Forest Insect Laboratory, Sault Ste. Marie, Ontario. History of the periodic outbreaks recorded for Ontario is presented, and the most recent outbreak (1948-1955), is described and mapped in detail.

Comparison of the last three outbreaks revealed three common characteristics: (a) expanding centers of infestation spread most frequently toward the east and south, (b) three large areas in Ontario escaped infestation, and (c) in any one locality infestation usually persisted for five consecutive years.

Study of the parasite complex was based mainly on series of three collections made annually at prescribed times at each of numerous collection points throughout Ontario. Supplementary collections were made as required to answer questions arising during the study. The parasite complex consists of 45 species of which 34 were reared. Four of these were new records as M. disstria parasites. A key was devised to separate puparia of the 10 common dipterous parasites. Only one species, Rogas sp., attacks young caterpillars; the remainder parasitize mature larvae, pupae, or eggs. Sarcophaga aldrichi Park., which attacks prepupae and pupae, was the most common, followed by two tachinids, Patello a pachypyga (A. & W.) and Leschenaultia exul Tns. Other parasites occurred much less frequently.

The emergence of a parasite from its host frequently climaxes a series of intra- and interspecific coactions. For example, two metopiid flies, Sarcophaga aldrichi and Pseudosarcophaga affinis (Fall.), although sometimes coexisting as maggots, rarely if ever tolerate other parasites. Such coactions obscure multiple and superparasitism in rearing experiments. Successful multiple parasitism involved only those species for which superparasitism is also known to occur.

Three patterns of parasitism were recognized during the five-year infestation. The ichneumonids tended to decrease each year throughout the infestation. Sarcophaga aldrichi increased regardless of major changes in the host population dehsity; and others either increased then decreased, or decreased then increased. The coactions within the complex produced these changes in the parasite populations as the infestations progressed.

Parasitism measurements were combined to represent the apparent fraction of late-larval populations that was prevented by parasites from emerging as moths. At first, parasite values remained low or increased slightly, but in the year that host populations began to decline they increased sharply and remained at a high level until the infestation ended.

The sex factor of M. disstria declined with age of infestation reaching its lowest value in the fourth and fifth years of infestation. Differential mortality reduces the proportion of females that survive due, in part, to starvation effects that favor the smaller males, and in part to the longer exposure of the female larvae to adverse physical conditions, parasites, and predators.

158 pages. $2.10.

A REVISION OF THE DIAPERINI OF AMERICA NORTH OF MEXICO, WITH NOTES ON EXTRALIMITAL SPECIES (COLEOPTERA:TENEBRIONIDAE)

(L. C. Card No. Mic 58-620)

Charles Albert Triplehorn, Ph.D.
Cornell University, 1957

This revision treats thirty four species in nine genera, thirty two species of which are found north of the Rio Grande. Insofar as possible, species from Central and South America and northern Europe were compared with the Nearctic fauna and, as a result, generic and tribal limits have been somewhat modified. Several new characters have been investigated and exploited, notably the structure of the male genitalia. Keys to genera and species of North American Diaperini have been prepared.

The following species have been described as new: Neomida aeneipennis (British Honduras), Neomida mylloc-nema (Lower California), Platydema teleops (Ohio), Platydema neglectum (California), Platydema wandae (Arizona).

Nomenclatorial changes involving North American species were as follows: Diaperis nigronotata Pic was raised to specific rank, Diaperis maculata floridana Blatchley was shown to be merely a clinal variation of the typical D. maculata Olivier, Neomida viridipennis (Fabricius), was shown to be a clinal variation of N. bicornis (Fabricius), Platydema crenatum LeConte was placed in synonymy with P. laevipes Haldeman, P. nigratum (Motschoulsky) replaced P. subquadratum (Motschoulsky) and Apsida

belti Bates replaced A. purpureomicans Bates in the North American fauna.

The only generic change made was Neomida Latreille which replaced Hoplocephala Laporte and Brullé.

As a result of the present study, several species formerly included in the Diaperini were transferred to other tribes. Scaphidema pictum Horn was transferred to the Phaleriini where a new genus, Phaleriamima, was erected to receive it. Uloporus Casey, a monotypic genus containing only ovalis Casey, was found to belong to the family Monommidae. 183 pages. $2.40.

A STUDY OF HAIR SIZE, HAIR SHAPE, AND DENSITY OF PIGMENT GRANULES IN HAIR FROM FOUR RACES OF MEN

(L. C. Card No. Mic 58-1011)

Donald Gibson Vernall, Ph.D.
University of Michigan, 1957

Measurements were made of cross sections of 30 hairs collected from the occipital region from each of 86 males, 20 to 30 years of age, who were living in the United States at the time of the study. Twenty of the males are Chinese, 21 Western Europeans, 26 Asiatic Indians and 19 Negroes.

Among the hairs from each person, variability is high for all of the characters measured: length of the major and minor axes, cross-section area, cross-section shape, and density of pigment granules at each of three quadrat positions: peripheral, intermediate and innermost. The within-person variances are high for each character measured.

Among those persons of each racial type who were examined in this study, variability also is high for all of these measures. Highly significant F values were obtained from an analysis of the among-person and within-person variability within each of the four races.

The variability among the races included in this study, for each of the seven traits measured, is significantly greater than the variability among persons within each race. Racial differences consequently do exist within this sample for each attribute.

The Chinese have the largest and most nearly round hairs of the four races measured in this study. They also have the greatest density of pigment granules in both the innermost and intermediate quadrat positions of the hair sections. In the peripheral quadrat positions, however, they rank third in the density of pigment granules in comparison with the other three races.

The Western Europeans included in this study have the smallest hairs in cross section of the four races studied. They also have the least density of pigment granules in all three quadrat positions.

The hair sections from Asiatic Indians examined in this study are indistinguishable in shape from the Western Europeans. Both are intermediate between the more nearly circular Chinese hair sections and the more elliptical Negro hair sections. In size of cross section, these Asiatic Indian hairs ranked second, being exceeded by the Chinese. In the peripheral quadrat position of the hair sections, the Asiatic Indians had the greatest mean density of pigment granules of any of the four races examined. In the innermost and intermediate quadrat positions, the Asiatic Indian hair sections were second to those of the Chinese in pigment-granule density.

The Negro hair sections average the most elliptical in cross-section shape of the four races included in this sample. In mean length of major axis, they are not significantly different from the Chinese, who average the largest. In the mean length of the minor axis, they are not significantly different from the Western Europeans, who average the smallest. Negroes have on the average more pigment granules than the Western Europeans in all three quadrat positions of the hair sections, but are outranked by the other two races in all but the peripheral quadrat, where the Chinese have fewer pigment granules than the Negroes.

Although the persons who supplied hair samples for this study may not be a random sample of the populations of their respective countries, bias was avoided so far as possible in collecting the hair samples, and it is believed that the differences between the races shown by these measurements indicate the type of racial differences which actually occur in hair characters. 57 pages. $2.00.

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